AVIATION

The Oldest American Aeronautical Magazine

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DECEMBER, 1932

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AVIATION

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The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

LOUIS F. STOLL, *Publishing Director*

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NEW YORK GETS ITS FIRST VIEW OF THE NEW PITCAIRN FOUR-PLACE CABIN AUTOGIRO

CAMP DIX, NEW JERSEY. During a display of modern foresters' equipment, under the direction of Colonel Leonidas Coyle, Fire Warden of the State, officials of twenty-five states recently witnessed a demonstration of the effectiveness of the Autogiro in forest preserve work. Two Kellett and two Pitcairn Autogiros were used.

BOSTON, MASS. A new unofficial world's altitude record for Autogiros, 21,500 feet, was established by Captain Lewis A. Yancey on September 25th at the East Boston Airport. Captain Yancey is aviation manager for the Champion Spark Plug Company, and made this record in a standard 300 h. p. Pitcairn Autogiro owned by that company.

PADILLA BAY, WASHINGTON. R. H. Bailey, who uses a Pitcairn Autogiro for patrol of his own extensive oyster beds, was recently awarded a contract which will greatly increase his flying activity. During the current season he will patrol the forests of the Olympic, Ranier, Mt. Baker and Snoqualmie Preserves.

WISCONSIN RAPIDS, WIS. Pilot David McMenamin of the Mulzer Flying Service, in the course of a tour of one-day stops at 25 towns in Wisconsin, Minnesota, North Dakota, Iowa and Illinois, carried more than eight hundred paying passengers in a Pitcairn Autogiro, during a period of thirty days.

GOLDFIELD, NEVADA. Al D. Meyers, veteran prospector of Goldfield, Nevada, who formerly covered the rugged country of the Western states "from the hurricane deck of a mule," has substituted a Kellett Autogiro, and immensely broadened the scope of his work in prospecting and surveying mining properties.

Since the first successful production of the Autogiro in America there has been a demand for greater passenger capacity and comfort. ⁘ ⁘ ⁘ The four-place cabin autogiro developed by Pitcairn Aircraft, Inc., therefore, represents another milestone in Autogiro progress. ⁘ ⁘ ⁘ There are now over sixty Autogiros in the hands of owners serving a wide variety of practical everyday purposes. ⁘ ⁘ ⁘ Upon receipt of request on business stationery a complete authoritative presentation of the Autogiro, in book form, will be sent without cost.

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AVIATION
FOR DECEMBER, 1932

Progress of aviation law

THE FIRST OF TWO ARTICLES

By
George W. Lupton, Jr.

IN the thirteenth century an obscure commentator on the Roman Code delivered himself of the erudite phrase: *"Cujus est solum ejus est usque ad coelum."* Freely translated this means, "He who owns the soil owns everything above and below from Heaven to Hell." In other words if you purchase a square acre of ground you thereby become lord and master of a limitless rectangular pyramid the vertex of which is exactly at the molten center of the earth and the base of which rests upon the Milky Way or beyond, and includes within its limits such suns, comets, planets and stars as might fall within its imaginary boundaries.

The phrase attained the dignity of a rule of law in the sixteenth century when Lord Coke repeated it. Even at this early date it had been applied in a practical way in a dispute over the ownership of six young goshawks and in another case involving overhanging eaves. Finally the famous Sir William Blackstone lent the magic of his name to the now firmly entrenched rule, and the courts never seriously questioned its universal applicability until the advent of the aeronaut. Coined at a time when flight by men had hardly been dreamed of, it has lived and flourished until now it confounds the eminent jurists confronted with the necessity of making new laws for the air.

In 1815 Lord Ellenborough questioned the rights of a balloonist to pass over privately owned land and from that time until the present day astute and verbose jurists have argued the soundness of the rule. If this decrepit maxim is sound law the aviator is a trespasser.

Ownership from Heaven to Hell?

A few eminent modern authorities have seriously contended that the rule should be strictly applied. If their conclusions are accepted by the courts each individual landowner, if he be so litigously inclined, can sue the owner of every airplane that passes over his land. In 1921 the legal adviser to the Chief of Air Service, U.S.A., caused a tempest in a teapot by expressing an opinion to the effect that every flight involves a series of trespasses amounting to a taking of property without due process of law. According to this respected authority the aviator and his passengers flying beyond the confines of the airport and passing over private property are law breakers, to be classed with the trespasser who walks over our newly seeded lawn. The fact that the damage done in each instance is but nominal does not alter the rights of the landowner. A constitutional amendment to remedy the defect in the law has been suggested.

In a case decided in 1922 by our all-powerful Supreme Court, the United States was, in effect, ordered to pay for the right to fire its big guns over property belonging to private owners on an island lying east of Portsmouth Harbor. The opinion, written by Mr. Justice Holmes, did not discuss in so many words the rights of a landowner to the super-jacent airspace but did take into consideration the fact that harm might be done by shells passing overhead and the effects of the concussions. Such a practice was held to impose

"such a servitude" as would constitute an "appropriation of property for which compensation should be made,"—undoubtedly a conscious or unconscious echo of Sir William's maxim. If the connotations of this decision are strictly followed the aviator is a trespasser.

However, more specific cases adopting the opposite view point have come before the courts. In Pennsylvania one Harold Nevin, an aviator, and his passenger were convicted for flying at a height of from 50 to 350 ft. over the farm of one Oscar Grube. Mr. Grube had posted "No Trespass" signs on his property. A local statute made it a crime to "wilfully enter upon land" if it were so posted. Harold used a landing field on the farm adjacent to Mr. Grube's and made short hops for hire. The lower court fined the defendants and also made them pay the costs. However, an enlightened upper court found the defendants "Not Guilty" and ordered Mr. Grube to pay the costs. The court decided that flight *over* the land was not entry *upon* the land—a reasonable decision if ever the courts have made one.

On Oct. 23, 1923, the United States Comptroller General disallowed damages alleged to be caused by an army plane which flew 50 ft. high over a field, causing 78 head of cattle to stampede, breaking down fences and scattering so far afield that it took three cowboys four days to round them up again. The matter was classed as "an accidental happening for which there is no liability in damages."

Seeking the middle ground

Thus there appears to be two irreconcilable theories applied by the courts. The first recognizes the landowners' absolute right to non-interference with the airspace above his land even to the furthermost heavens. The second recognizes the absolute right of the aviator to use the air as he sees fit. Between the two is a middle ground upon which the law must eventually settle in order that the interests of all concerned may be protected.

The theory of absolute ownership to the skies has fallen into mild disrepute especially since the advent of the airplane. The few cases that have come before the courts to question the applicability of the rule have been decided in favor of a modified rule. Judges, using their God-given common sense, ignore the old maxim entirely or dismiss it with a wave of their legal hands, contemptuously calling it a "fanciful phrase" or flatly stating that "the upper air is a natural heritage common to all of the people, and its reasonable use ought not to be hampered by an ancient artificial maxim of law."

A number of arguments against the rule stated by the maxim are readily available. Its very wording has been examined minutely and at least one flaw has been discovered which changes its meaning to something less than appears at first blush.

Your old Latin professor will tell you that *coelum* (sky) refers to the lower airspace,—the area in which the birds fly and the clouds drift. It is only up to the beginning of the space used by the birds and in which the clouds are to be found. Furthermore, the cases which have applied the maxim for the benefit of the landowner have been cases involving overhanging eaves and spreading trees, telephone wires and the like. In each of these cases a tangible harm was done the landowner. Aircraft had not been conceived of when the maxim flourished in its pristine glory. The impossibility of the landowner using his land more than a few hundred feet above the surface is obvious. After all, the air is inherently navigable. As such it has a kind of general public utility. Simply because the public has not used it before is no reason to say it should not now use it.

Again it has been repeatedly stated, both by the professional lawyer and the sociologist, that modern conditions require modern rules of law. Although our law is taken almost bodily from the English common law, yet English law does not always fit American conditions. Rights to water used for drinking and irrigation, for example, differ vastly in the two countries because of the physical difference between England and the United States. The water law of the states along the eastern seaboard differs from that in the arid Western states. In a similar manner aviation confronts the law with a new condition. The law should be made to conform to the practice of the people. Even though at one time the landowner indisputably had a vested right in the space above his land new conditions necessitate the taking of that right. If the common weal demands the docking of a right which, after all, is practically useless to the landowner even though it be vested, let us not hesitate to do the docking. If the police power of the state is strong enough to limit the height of buildings in the common interest, certainly it is strong enough to curtail the private owner's rights in a much less obnoxious manner by giving the airplane free though reasonable passage through the air.

"'He who owns the soil owns everything above and below from Heaven to Hell.' In other words if you purchase a square acre of ground you thereby become lord and master of a limitless rectangular pyramid the vertex of which is exactly at the molten center of the earth and the base of which rests upon the Milky Way or beyond, and includes within its limits such suns, comets, planets and stars as might fall within its imaginary boundaries."

A 20th Amendment?

Two remedies have been suggested. First, that the right of the landowner to the unused portion of the upper airspace be condemned in favor of the public. That would give lawyers employment, but the overburdened taxpayer, as usual, would be the ultimate loser. The other remedy, as has already been mentioned, is a more feasible one, to wit, an amendment to the Constitution.

Familiarity, it is said, breeds contempt. Such an amendment should respect the landowner's right to a freedom from interference. However, our newest infant industry is entitled to a guarantee that its very breath of life shall not be taken away by the vagaries of a few old-fashioned judges who, by applying medieval rules of law, may punch legal airpockets in the air at the instigation of every cantankerous landowner that doesn't happen to approve of the newfangled airplane.

Members of the bar are wont to say that "The man who is his own lawyer has a fool for a client." It may be so, but we cannot all carry our legal advisors around with us at every step we take, and we ought to know at least enough about the law to have some idea of how likely we are to be getting into trouble without realizing it. Mr. Lupton has undertaken in two articles, of which this is the first, to show us some of the ways in which we might get into trouble, and not only to point out where the legal pitfalls lie, but to indicate how they might be filled up and made harmless.

The Uniform State Law for Aeronautics, adopted by at least twelve states and territories, specifically reserves a right of flight but the constitutionality of the statute has yet to be tested. That an interference with the landowner's historical rights may well be unconstitutional is admitted by even Philadelphia lawyers. The Uniform Law, Section 4, provides:

"Lawfulness of Flight. Flight in aircraft over the lands and waters of this state is lawful, unless at such a low altitude as to interfere with the then existing use to which the land or water is put by the owner, or unless so conducted as to be imminently dangerous to persons or property lawfully on land or water beneath. The landing of an aircraft on the lands or waters of another, without his consent, is unlawful, except in the case of a forced landing. For damages caused by a forced landing, however, the owner or lessee of the aircraft or the aeronaut shall be liable as provided in Section 5."

Federal legislation, based on theories of sovereignty and passed in pursuance of the authority of Congress to regulate interstate commerce, undoubtedly protects the interstate flyer in subjecting the landowner to a reasonable use by the aviator of the air space over his land.

Another type of case bids fair to present even a more burning question to the courts. It is not a question that can be easily disposed of by the mere passage of a statute or a Constitutional amendment. A perfect example of this new problem was before the courts of Massachusetts. The facts were these:

Two basic airport cases

One wealthy Harry Worcester Smith owned a country estate near Worcester, regally named "Lordvale" and some 400 acres in extent. In 1927 several companies and individuals interested in various phases of aviation proceeded to develop and use the adjoining 95 acres as an airport. Smith alleged that the planes flying over his place annoyed him and his family, his guests and servants, his blooded horses and other livestock. One month 120 flights were counted by Smith and his secretary. He claimed that the planes not only trespassed on his property but were a nuisance, and he asked for an injunction restraining their activities. A commissioner was appointed and made a detailed report as to the activities in and around the airport. The court, basing its rulings on the facts as found by the commissioner, decided against Smith both as to the nuisance feature of the case and the trespass charge. The point really decided was that Smith's injuries were more fancy than fact. Under slightly different circumstances, the court might well have held the defendants liable for the trespasses upon the theory that they were interfering with the landowner's quiet enjoyment of his premises, and also enjoined them from repeating the offence in the future.

The feature of the case that causes one to pause and ponder is that concerned with the claim of nuisance. What of the owner of a valuable apartment house near to a newly-opened airport, whose tenants have all fled from the hum of motors by day and the intermittent flashes of high-powered beacons at night? One of the Curtiss-Wright airports and Roosevelt Field have run afoul of the district attorney's office of Nassau County in New York on just such a count. It seems that planes droned over the roof tops of nearby residents all night long, their pilots collecting night-flying time for transport licenses. An amicable adjustment was made when an eleven o'clock summer and ten o'clock winter curfew was put into effect. These instances are proof of a problem that will become more acute as the airplane becomes more universally used. The situations suggested are peculiar to metropolitan areas. No satisfactory method of filling this type of legal airpocket has yet been suggested. Each individual case must be decided on its merits. The courts must balance the conflicting interests of the aviation industry on the one hand and the nearby landowner's on the other, constantly keeping in mind the welfare of the public at large.

A recent case

The most recent case on this subject was decided by the Circuit Court of Appeals, Sixth Circuit, on Jan. 8 this year. The plaintiffs had developed a 135-acre residential tract at a cost of $115,000. Subsequently the Curtiss Airports Corporation purchased a 272-acre tract immediately across the road, and proceeded to develop an airport for its Cleveland business. Plaintiffs contended that the operation of the field was a nuisance, and that flight of planes at any altitude over their property was a trespass. The plaintiffs secured a injunction from the lower court whic enjoined the Curtiss Corporation fron permitting dust in substantial quantities to drift over the plaintiffs' property and from flying or permitting airplanes under its control to fly over it at an altitude of less than 500 ft. The upper court, after enumerating all the activities attendant upon the operation of a large flying field and school with its shops, beacons, boundary lights, hangars, automobile parking area, its students constantly warming up their motors and practicing take-offs and landings, and after pointing out that this particular site was not indispensable to public interest, there being other available and convenient sites, and indicating that it believed the plantiffs had suffered considerable damage and inconvenience, said:

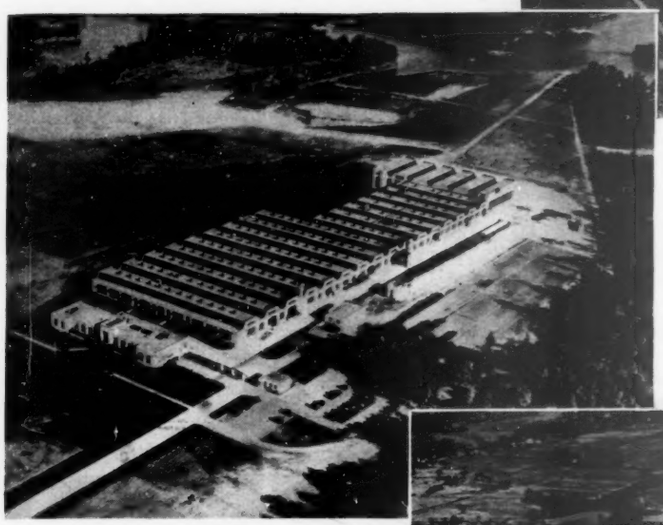
"The defendants have the right to establish airports, but they cannot lawfully establish one at a place where its normal operation will deprive plaintiffs of the use and enjoyment of their property.

"Considering, therefore, the balance of conveniences, the defendants are not entitled to use the property as they now contemplate."

The most obvious fallacy in this opinion is the assumption that the convenience of the plaintiffs is to be balanced against the convenience of the defendants. The court admits that these are cases in which the landowner must submit to great annoyance in the interest of the public. If the logic of this case had been uniformly applied to the railroad in its early development it would have been almost impossible for the railroad to have constructed large terminals in the very hearts of our cities. In other words, the court, in balancing the conveniences, has failed to add to the scale the tremendous factor of the public necessity for all airport facilities.

The effect of the trial court's rulings in the Cleveland case, if generally upheld, would be to erect a 500-ft. wall around each airport. In other words, granting that the minimum gliding ratio of the airplane is seven to one, a 3,500-ft. border will have to be added to every airport.

Airplane plants from the air



Above: The new Kenmore plant of Curtiss-Wright at Buffalo which turns out military ships for the services. C-W commercial types come from the Robertson (Mo.) factory. Both are supplied with engines from the Wright Aeronautical subsidiary at Paterson, N. J. Left: An ideal lay-out for land and water operations. The Glenn Martin factory near Baltimore not only has a large and unobstructed field, but also has access to an arm of Chesapeake Bay. Note the runway and ramp.

Above: United Aircraft's threefold operation at Hartford. In the left foreground is the huge plant where Pratt and Whitney engines are designed, tested, and produced. To the right lies the home of the well-known Chance Vought Corsair. In the background is Bentchler Field and the shops and hangars of United Airports of Connecticut. Engine servicing formerly handled by the factory is now conducted by this subsidiary.

Above: Boeing's long line of fighting and civil aircraft first try their wings from this plant on the shores of Puget Sound at Seattle. This company has been manufacturing airplanes in this location since 1916. Right: The real starting point of the famous round-the-world flight of the U. S. Army Air Corps in 1924. The Douglas factory at Santa Monica, Cal. now engaged in turning out military and commercial ships, as it it appears to-day.

'Way back in 1930 it used to be fashionable for us to admit that we had been making the mistake of trying to sell airplanes and equipment only to each other, and taking the great outside public for granted. In some cases that indictment still has much truth in it, even though the parties concerned may not realize it at all and may think they are doing everything possible to reach the untouched private market. Mr. Rockefeller doesn't think they are, and he is a private owner-pilot who had to be converted himself. Now he has some suggestions to offer on how the industry can convert others, and he does it with so light a touch that you can at least be sure of getting a lot of entertainment from his article. Incidentally, you may get some very useful suggestions.

Growing wings on the business man

By J. W. Rockefeller, Jr.

WHAT is the future of the aviation companies? In which direction lies their most promising market? What are the steps necessary to plant both wheels and tailskid in that market at the earliest possible date?

Fifteen years after the War, aviation must still be considered an infant industry. It is true that passenger traffic upon established transport lines has increased steadily. Upon the transport business and government contracts the aviation industry of today is almost entirely dependent. How far will the industry expand if it continues to rely solely upon these two outlets for the products of its manufacture? It will be a long time yet before the most ardent advocates of pacifism will bring the last army airman out of the skies. Still who can deny that the trend is in the general direction of smaller appropriations for national defense?

Travel over established airlines will become increasingly popular. In time the number of passengers carried by air may equal the number carried by rail. Still it is not through this channel that the chief promise of expansion lies. The hope of the aircraft manufacturer lies in selling outside the industry—in selling private planes to millions of individuals who at this writing have no desire to travel by air, and who in all probability would not accept the finest airplane made as a gift if the acceptance carried with it an obligation to use it as a regular means of conveyance.

The isolated attempts which have been made to reach the new private owner,

the man who is entirely outside the industry, have almost without exception been woefully ineffective. We may enumerate the four steps in general advertising and selling as follows: (1) attracting attention; (2) arousing interest; (3) convincing the prospect; (4) obtaining favorable action.

Few campaigns aimed at the private owner have been carried past the second step. To say that steps one and two have been taken with decided overzealousness would be a pathetic understatement. One airport near New York is advertised along the highways as "the most thrilling place in the world." The family of the man in the motor car out for its Sunday airing reads "thrilling" as "dangerous," and it is unanimously agreed that in view of the fact that a parachute may fail to open at the critical moment the airport advertised will be the logical place to stop for a bite of lunch. This advertising sells more frankfurters than airplanes.

Negative salesmanship

Last summer the owner of a night club which is located on a small lake asked the writer's opinion regarding the possibility of transporting a musical comedy attraction from New York by plane and landing on the lake. The transportation was considered for a Saturday night, a time at which the surface of the lake is usually pretty well crowded with canoes and other small craft. The manager of the local airport and the writer concurred in the opinion that the venture would be decidedly dangerous; that some unknown canoeist might steal the show's anticipated publicity and become the unwilling newspaper headliner by virtue of a horrible death. This deterred neither the night club owner nor the singer, who was landed safely and who warbled successfully through her program. The pilot, if the writer's memory serves him well, was subjected to a technical arrest; at any rate another chapter was written in the history of flying.

Everyone connected either directly or indirectly with the aviation industry can cite from his personal experiences a score of similar cases. The airplane has been relentlessly seized upon by pub-

licity-hungry egomaniacs in all walks of life to such an extent that when the industry finally undertakes a carefully planned marketing campaign to sell the general public it must needs start from a mark some distance behind scratch.

Due to the fact that few serious efforts have really been made to sell aircraft outside the industry, the manufacturer has seldom attempted to translate his message into terms readily understandable by one who has the means but not the inclination to make a purchase. The language of the hangar accomplishes its purpose of supplying "realism" in the wood-pulp thriller, as surely as does the flame-enveloped and slightly-out-of-register Bristol that goes crashing to destruction on the magazine's cover. As a first step toward making the uninitiated feel at home in a strange element, hangar language is somewhat less convincing.

The very devices used, with the best intentions in the world, in attempted sales campaigns are sometimes a little worse than ludicrous if considered as addressed to a brand-new prospect having no experience in aeronautics and a full quota of timidity. Not many months ago the writer saw a leaflet proclaiming the charms of a small plane of moderate price, particularly suited for the private owner. A list of standard equipment was conspicuously displayed below the picture of the plane, and the first item was: "Complete first-aid kit."

In no other industry is the gulf between the prospect and the purchaser so great as in the aircraft field. Almost every piece of printed matter ever designed for public consumption has tended to separate rather than draw closer together the two. Thus the increased cruising speeds which have been attained during the past few years in small planes of low horsepower may react unfavorably in the mind of the man who has never flown a plane and in whose thinking process speed is invariably associated with danger. One hundred miles an hour is translated into the terms of travel with which he is most familiar. If he is an average individual, he may have occupied a rear seat in a motor car while the dashboard instrument indicated a speed of 70 or 80 miles an hour, and may harbor no very intense desire to repeat the experience. It is one of the tasks of advertising to associate air speeds with leisurely, rocking-chair travel, rather than with mad moments in an automobile gone berserk.

The problem of the school is very much the same as that of the manufacturing organization. To date (though there seems to have been some relative improvement in the last few months) the instruction centers have been but poor feeders for the sales companies, turning out many pilots but few plane purchasers. The average student enrolling for a course of instruction in flying has been motivated by the belief that after 50 hours in the air he could depend upon the industry for a sole and exciting means of support. Between the extremes of those who consider flying a short cut to wealth and that somewhat more populous class who will stubbornly continue to regard it as a short cut to eternity there lies a market as yet entirely undeveloped, and one which once enlisted will start aviation toward a goal which the automotive industry has already attained.

A new approach

In fairness to those pilots who have already spent years in learning their chosen profession, as well as in the interests of flying generally, this market should be intelligently approached and developed at once. It comprises those hundreds of thousands of individuals in various occupations who can make air travel a pleasant means of recreation, a convenient method of transportation and a decided business asset.

What has the airplane to offer this class as a means of transportation? Speed, to be sure. Speeds so high that in many cases they are a sales handicap rather than an aid. The following excerpt is from the New York *Evening Post* editorial page of Jan. 23, 1932, under a caption "Those Antique Cars."

"We boast of our speeds today, but in 1911 Ray Harroun piloted a Marmon around the brick oval at Indianapolis for 500 miles at an average speed of 74.59 miles an hour. Today we achieve 1911's racing speed in our passenger cars. The cars of twenty years ago were clumsy, rough riding, awkward, hard to drive and high in price. Today's cars are creations of beauty, fitted with every convenience and ridiculously low in price."

The motor industry in 1911 had already developed enough speed to last for twenty years, while it very sensibly set about to make its product more comfortable, of improved appearance and lower in price.

The private plane purchaser of today must be approached with the idea of satisfying his actual requirements rather than with any thought of making him the recipient of a surplus commodity which the trade has to offer. Let us consider as an example a resident of Long Island who will make frequent trips to New Jersey or New England. The all-road trip from Valley Stream, Long Island to Red Bank, New Jersey is approximately 80 miles; by air less than 40. The trip by road can be made in about four hours, provided traffic is not heavy. A plane cruising at 80 miles an hour will arrive at Red Bank 30 minutes after taking off from Valley Stream; at 100 miles an hour 24 minutes will be required; at 120 miles an hour twenty minutes. The saving of 3½ hours is a decidedly interesting advantage; the saving of four minutes is hardly of consequence. If the trip is 500 miles against a 30-mile headwind, a better case, to be sure, for the 120-mile cruising speed, but we are now considering the case of the purchaser outside the trade and for such a one these conditions would obtain infrequently indeed. The 500-mile trip would be an abnormality.

The matter of safety is the one uppermost in the minds of those who form that large class upon which the industry must depend in gaining maturity. In 1930 the number of automobile-miles travelled per personal injury was 145,000. In the first six months of the same year civilian airplanes flew a distance of 130,000 miles per personal injury. Considering the difference in mileage it will be seen that in going from Red Bank to Valley Stream the average traveller by air has a better chance than the average automobilist of reaching his destination without inflicting injury upon himself or someone else.

Peace of mind

The comfort of air travel is so much taken for granted by those of the flying fraternity that it is seldom sufficiently emphasized in any marketing effort aimed at the public. The peace of mind enjoyed by the air pilot has no counterpart on the road. Sailing smoothly along a concrete highway 10 miles wide with no traffic and a complete absence of crossroads, with the road banked at his desire by the slightest pressure on the steering wheel, is the dream of the motorist—the daily lot of the pilot.

The aviation industry has to offer to the prospective plane owner safety, comfort and speed of travel. To prove flying a safe means of transportation is merely a matter of mathematics; to make the prospect feel such security is a problem of advertising—a problem, the undertaking of which is better left in the hands of one whose proximity to aeronautics has not rendered him entirely incapable of seeing eye to eye with him whom he essays to convince.

The terms of the ground traveller are inadequate indeed to describe the comforts of a journey through the air. However, even in his own language they may be portrayed with sufficient enticement at least to awaken his interest. Speed is universally conceded. It need not be stressed, and there are positive disadvantages in forcing it too much upon the attention of the type of potential customer of whom we have been talking. There is a great potential market for aircraft waiting to be convinced. It cannot be made enthusiastic about hanging on top of a loop. It can be interested in safety, comfort and rapid transportation, and once convinced that these are obtainable it will absorb private planes in hundreds of thousands.

Before the recent work of the National Advisory Committee on Aeronautics on lateral control at low speed, little attention was paid in this country to the design details of wing slots or slotted ailerons. Consequently, many attempts to derive the obvious benefits from these principles produced negative results. The author of the accompanying article is well qualified to discuss the subject, having been technical assistant to F. Handley Page before coming to the United States. The statically balanced and slotted ailerons of the Douglas Dolphin are among his contributions to American aircraft design.

Design of slotted ailerons

By Stanley H. Evans

Associate Fellow
Royal Aeronautical Society

SLOTTED AILERONS of the type originated by Handley Page in England are a comparatively recent innovation in this country, though they have been used with success for a number of years abroad. Since they possess several desirable characteristics rendering them superior to more conventional ailerons, the writer is encouraged to offer the present notes and design data from an extended experience with this type: particularly so since an inspection of some recent commercial airplanes, claiming to feature them, reveals an apparent misconception of the true function and geometry of the slot for most effective lateral control. In fact, in some cases, widely advertised as "slotted ailerons," the so-called slot action is not merely absent or mutilated, but completely reversed, as will be shown later.

Definition

At the outset it should be made perfectly clear that this article does not aim to discuss the joint front-slot-and-aileron control mechanism, still under development by the Handley Page Company and the British Aeronautical Research Committee. Just now, we propose considering only a type of aileron balanced along an axis behind its leading edge and incorporating a venturi-shaped slot formed behind the rear wing spar and the aileron nose. That type we shall designate simply as a "Slotted Aileron."

Nowadays, it is generally conceded by most designers that some degree of aerodynamic balance is essential for ailerons, the lateral control usually being the most difficult to bring to the required degree of effectiveness. The ideal control system, of course, should be harmoniously co-ordinated; that is, equally responsive about all three control axes.

Furthermore, it is recognized that the ailerons have a decisive effect on the stability in stalled flight. Other features of a design being normal, conventional ailerons are the most potent cause of the involuntary spin. We know that deflection of the ailerons causes rotation about two axes perpendicular to each other, a rolling motion about the longitudinal axis of the airplane, due to the change of lift, and a yawing motion about the vertical axis, set up by the difference in drag of the two sides. Unfortunately, this yawing moment is an adverse one, opposing the desired direction of the turn, and so requiring the action of a correcting rudder force to overcome the undesirable aileron drag. At low angles of attack the ailerons generate very large rolling moments, accompanied by relatively small yawing moments: on stalling, however, the rolling moments become much smaller and the yawing moments increase until the two may actually reach the same order of magnitude.

The basic aileron problem

For this reason a normal size rudder, effective enough at low angles of attack of the wing, becomes increasingly defective beyond the stall, though considerable improvement may be effected by a favorable disposition of its area in relation to the fuselage and horizontal tail,—a point not always appreciated, judging by the examples of poor rudder design frequently seen. Approaching the critical angle and beyond, in the régime of stalled flight, we have noted that the adverse yawing couple assumes serious proportions, due mainly to the disproportionate rise in profile drag of the depressed aileron caused by "burbling"; while, at the same time, this burbling causes a breakdown in the lift and rapid fall-off of the rolling moment. The yawing moment of conventional ailerons can, in stalled flight, assume high values and far overpower the effect of ordinary rudders.

For the prevention of the involuntary spin we see, then, the desirability of developing an aileron design which will neutralize, or if possible reverse, the objectionable yawing moment, especially beyond the stall. Here let it be admitted at once that the simple slotted aileron under discussion is but a partial remedy in the required direction, but for ordinary wings employing only rear flaps as ailerons (and not inter-connected to a front-slot airfoil), it is believed the slotted type represents the best solution, for besides maintaining the rolling moment reasonably well at the critical angle and even reversing the opposing yawing moment beyond the stall it is quite easy, by suitable location of the inset hinge, to obtain the requisite degree of aerodynamic balance considered necessary for good control. Apart from aerodynamic considerations, moreover, the inset-hinge aileron readily lends

itself to static balancing, a point of critical importance for the avoidance of wing and aileron flutter in high speed designs.

Slotted aileron development

It is interesting to trace the evolution of the slotted aileron from the earlier symmetrical pattern employing the inset hinge type of balance, first introduced on the Handley Page twin-engined bombers in 1916-17. This form can rightly be claimed as the most satisfactory all-round solution at that time, and until the advent of the Bristol "Frise" type, which is really an ingenious adaptation of the Handley Page. The Frise aileron (so named after its inventor, a member of the Bristol design staff) has been very widely adopted in this and many other countries, sufficient warranty that it successfully achieves a light and responsive control throughout a wide range of angle of attack. The balance principle is essentially the same as the Handley Page, the degree of balance being obtained by locating the hinge axis aft of the leading edge and forward of the aileron center of pressure, usually at a point varying between 20 per cent and 25 per cent of the aileron chord. The aerodynamic action of the Frise type is well understood. The nose of the raised aileron, when projecting below the lower surface of the wing, contributes to an appreciable reduction of the adverse yawing couple by introducing an added drag or braking effect on the falling wing-tip.

Fig. 1: Desired slot action mutilated by poorly shaped slot.

With the brilliant conception of the slotted wing by Handley Page, it was not long before that company experimented with a rear slotted flap, primarily used in conjunction with a front slot, and intended to augment further the lift from the slot action. Many different forms and hinge positions were tried out, crystallizing today in a shape similar to Fig. 6. When used as an aileron this is, in many respects, similar to the Frise pattern, but whereas in the latter the vertical position of the hinge is not critical, within wide limits (ranging, in different designs, from upper to lower surface of the wing), in the slotted type the hinge location, vertically, is narrowly restricted to a point on, or just below, the lower surface of the aileron. Incidentally, from a constructional point of view, this position is most convenient, allowing the hinge-pin or ball-bearing to be carried just clear of the aileron surface, and so readily accessible for assembly and inspection.

Where designers go wrong

It will be instructive at this point to examine two examples of poorly designed aileron slots actually seen in current service, as they serve to emphasize certain objectionable features mentioned in opening these notes. The aileron outlined in Fig. 1 represents a mutilated slot, presumably maltreated in this manner in the interests of cheap and rapid production. It is charitable to suppose that its creator must be something of an optimist—to say the least—for the slot action is more apparent than real. Fig. 2 illustrates a reversed slot action, the result of raising the hinge and centering it inside the aileron profile, such as would be the case, for example, in a design employing a torque-tube construction for the aileron main spar. Several commercial designs have been noted with the hinge located in this way and the resultant geometry should be clear from the sketch: it shows the slot exit opening up on the *raised* aileron and practically muzzled on the *depressed* one, an opposite effect to that desired, tending to reduce the rolling moment instead of increasing it. Of course in both these examples the inset balance principle is still there, and remains sound enough, but the designer might with advantage have eliminated the slot idea altogether and concentrated on the straightforward Frise pattern, since a badly-proportioned slot, forming a gap in the under surface of the wing, fills no useful function and could better be faired close up to the aileron nose in the neutral position. An excellent example of the Frise aileron, showing how this type can be snugly faired without a hinge gap in the wing profile, is installed on the Fleet "Trainer" Biplane, and the writer has no hesitation in recommending such an arrangement as superior to the badly designed slotted types of Figs. 1 and 2.

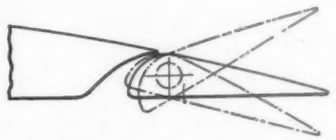


Fig. 2: Desired slot action reversed by aileron travel.

We have observed that the hinge of the slotted type is restricted in its vertical location and reference to Fig. 3, depicting a well tried and successful lay-out, clearly shows how the pivot point controls the changing shape and width of the slot throughout the angular throw of the aileron. The point to note is that at the upward limit of the raised aileron, the slot is just closed at its exit on the upper surface, with the aileron nose projecting as an air-brake, or "spoiler," below the lower surface, thus choking the airflow and adding to the drag on that side of the wing. On the other side, however, the depressed aileron has opened up the slot exit to its designed maximum, forming a bell-mouthed venturi, allowing air at high velocity to flow through from the pressure to the suction side, and so cleaning away some of the turbulence over the upper surface of the wing. Comparison of the Frise with the slotted aileron would lead us to expect that the latter, besides possessing all the advantages of the Frise as regards the drag increment produced by the projecting nose on one side, should also derive an augmented rolling moment (in both normal and stalled attitudes) from the increased lift of the fully opened slot, on the other side.

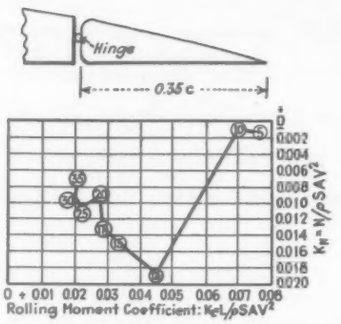


Fig. 4: Standard unbalanced aileron.

How slots work

The soundness of this reasoning has been convincingly demonstrated by experimental data obtained at the Royal Aircraft Establishment (Brit. Aero

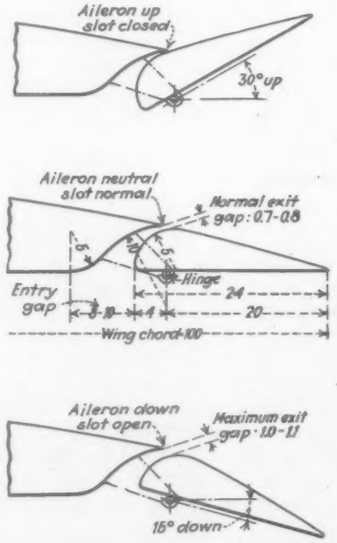


Fig. 3: Correct design of slotted aileron. Typical layout, medium-thick wing.

Res. Comm. R. & M. 1048: "Slot & Aileron Control on a Wing (RAF-31) with Various Types of Ailerons." Bradfield & Hartshorn) and presented here in the vector diagrams of Figs. 4, 5, and 6. In these diagrams, Yawing Moment is plotted against Rolling Moment, for an aileron movement of 20 deg. either side of neutral, the moments being expressed in terms of non-dimensional coefficients. The adverse yaw, opposing the roll, is represented as a negative coefficient, while the positive sign denotes a yaw favorable to the direction of the turn. The breakdown of the standard aileron (Fig. 4) at the stalling angle, around 11 deg., is well marked; likewise the improvement of the Frise (Fig. 5) and slotted (Fig. 6) types in this respect. The all-round

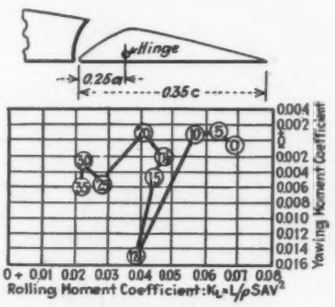


Fig. 5: Bristol Frise aileron.

superiority of the slotted aileron, both in strength of roll and reduction of adverse yaw, is clear. The maximum negative yaw is barely half that for the simple aileron, while the roll is slightly increased. The slotted aileron by itself, however, is still inferior to the more fundamental solution seen in the interconnected slot and aileron control, previously cited.

In view of our previous remarks on the desirability of avoiding any *unnecessary* discontinuity in the wing profile, it may be pertinent to examine whether the gap in the lower surface, necessary in the case of a slotted aileron, does introduce any detrimental effect on the wing drag, more especially at low angle of attack in the region of minimum profile drag. An analysis of early British tests on a moderately thick section (thickness/chord ratio about 13 per cent, with slotted trailing flap showed little effect, either on minimum drag or lift/drag ratio, whereas later results on a more modern and thinner section, with a rear slotted flap extending across the full span indicate that the minimum drag is increased about 10 per cent, though still without appreciable alteration in the maximum lift/drag ratio. Now since in the case of average span ailerons, covering from 50 to 70 per cent of the wing span, the increase would probably be of the order of 5 to 7 per cent addition to the maximum wing drag, the effect of slotting on top-speed performance would be of the order of 1 per cent, and climb and ceiling would be quite unaffected. Naturally, such a result is only to be expected with a well proportioned slot on the lines of Fig. 3. With poorly shaped slots, such as those exemplified in Fig. 2, it is practically certain that not only would the minimum drag be increased, but the lift/drag ratios would be appreciably lowered by reason of the muzzling action of the slot formation with ailerons in the neutral position.

The question of model scale of course has some influence on the shape of the Rolling/Yawing Movement curves in the region of the stall. The vector diagrams of Fig. 4, 5, and 6 were plotted from model data taken at a very low speed of test and on a very small model, and the early stall, around 11 deg. angle of attack of the wing, is very noticeable. A more recent test at a much higher Reynolds Number, shows that while the objectionable "bump" is still present it occurs later, around 16 deg. angle of attack.

Final remarks

Before closing these notes, some final remarks on the correct formation of the rear slot and aileron, as evidenced by the typical lay-out of Fig. 3, are appropriate. As regards the aileron, the importance of the hinge location has been stressed. We have seen that, vertically, it should be below the lower surface, just close enough to give comfortable clearance for the pin or bearing and, of course, taking care to avoid an ugly-looking bracket protruding too far outside the wing profile; horizontally, it will be governed by the degree of aerodynamic balance required—usually between 16 per cent and 20 per cent of the total aileron chord is quite sufficient on normal size aircraft, especially when employing a differential movement of the ailerons, a moderate degree of which, say a 2-1 ratio, is strongly recommended. The accompanying lay-out employs this ratio, the slot formation being designed to accommodate an upward and downward travel of 30 deg. and 15 deg., respectively, which together with a balance ratio of ⅓ gives a light and powerful control right down to stalling and even beyond. With these proportions, the total aileron chord should not exceed 25 per cent of the main wing chord, and may even be reduced to 15 per cent in many designs, since long, narrow ailerons of high aspect ratio are known to be the most efficient. With the typical lay-out shown, the aileron span should cover at least 60 to 70 per cent of the semi-span of the wings. If full static balancing of the aileron is considered necessary for structural stability of the wing system, the nose portion forward of the hinge may be covered with a fairly heavy gage metal skin, thus bringing the center of gravity locus coincident with the hinge axis. The Douglas amphibian, the "Dolphin," employs statically balanced and slotted ailerons covering about 70 per cent of the tapered cantilever wing, and may be accepted as typical of the modern trend along these lines.

Regarding the shape of the slot itself, this is frankly a matter of experience and judgment with a certain amount of trial and error. It will vary somewhat, according to the airfoil thickness and the aileron chord. For the typical example of Fig. 3, a medium-thick section with thickness/chord ratio about 12 per cent, similar to the Clark-Y and the RAF-31, is represented. The basic dimensions to observe are the slot entry and exit gaps, measured as shown in the sketch, —all dimensions, as usual, being expressed in percentage of the wing chord adjoining the aileron. The entry gap is generally about 8 to 10 per cent, measured along the chord, while the exit gap should develop not less than 1 per cent in the fully open condition with maximum downward travel of the aileron at 15 deg. When laying out, with aileron neutral, this usually means an exit gap of 0.7 to 0.8 per cent. If used on a smaller chord aileron, or an airfoil section of widely different thickness ratio from that typified, some adjust-

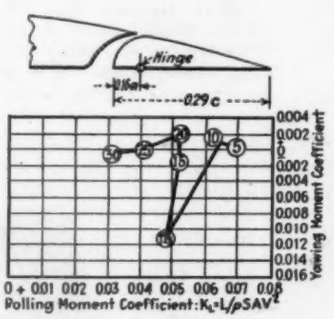
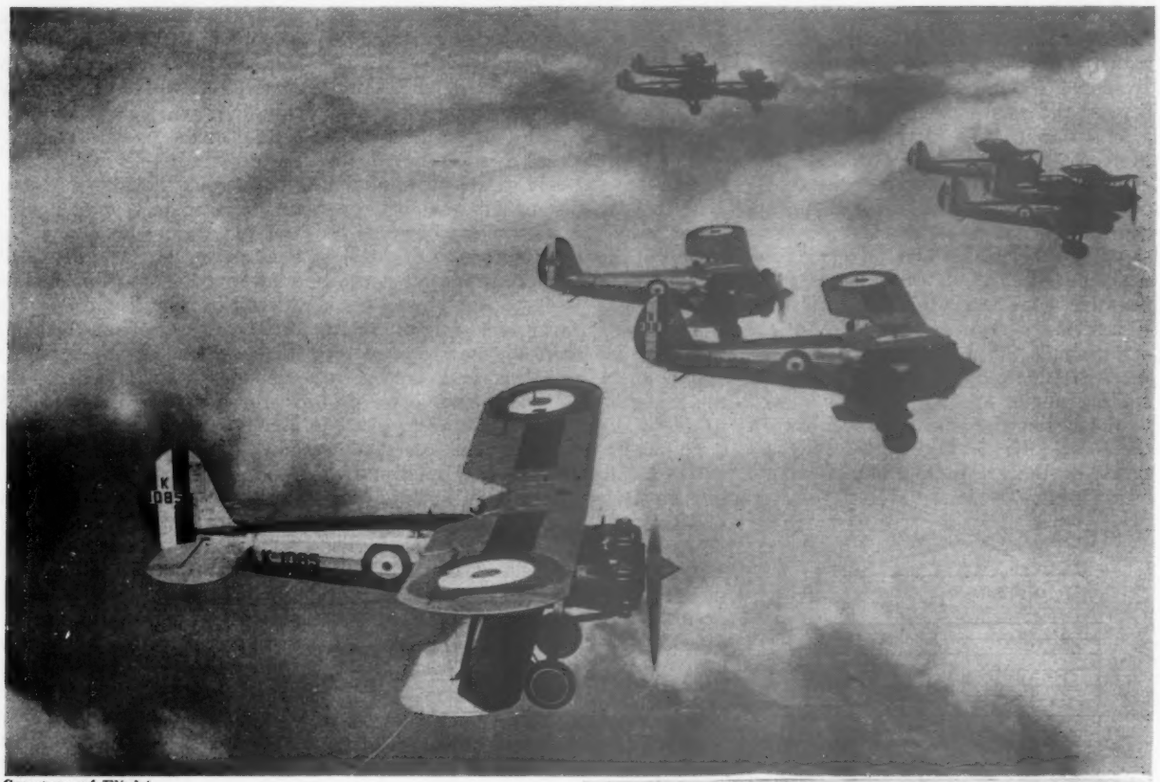


Fig. 6: Handley Page slotted aileron.

ment of these proportions will be necessary, but the average draftsman can lay out a design to suit his own particular case without difficulty.

In closing, it is hoped that these notes and sketches may prove helpful to fellow workers interested in the subject of adequate lateral control at low speed. If they serve to open up a discussion and critical examination of the claims for this type of balanced aileron, so much the better; while if, perchance, they lead to a wider adoption, and a more intelligent application, of its use on this side, the writer will be well repaid. Since its inception some ten years ago, and in spite of apparent neglect outside of Great Britain, he remains an unrepentant believer in the slotted wing generally: a faith in which he has been encouraged by its outstanding performance in the Guggenheim Safe-Aircraft Competition.



Courtesy of Flight

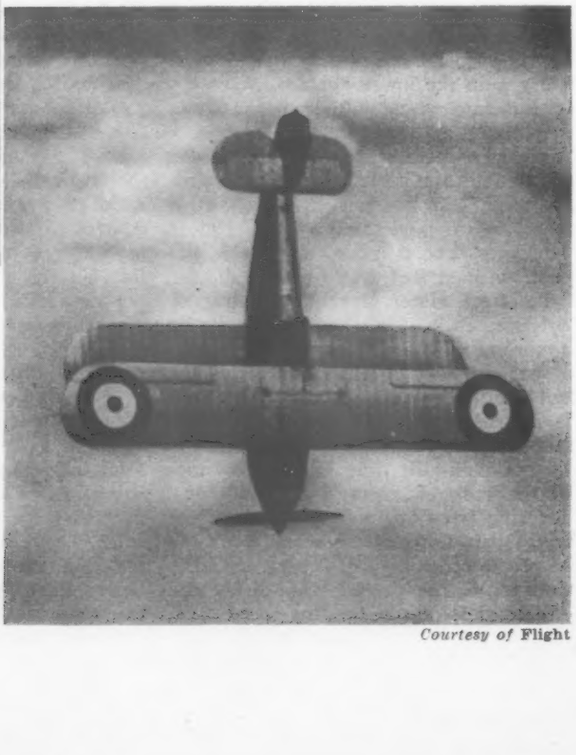
Above: Standard high altitude fighters of the Royal Air Force, Bristol Bulldogs (Bristol Jupiter engines). Below: The Wapiti, all-metal construction, and suitable for bombing, reconnaissance, photography, and other jobs (Bristol Jupiter engine).

Courtesy of Flight

Above: The Bristol 120, general-purpose aircraft with the "glass house" cupola gun turret (Bristol Pegasus engine). Below: A Hawker Nimrod, fleet fighter, in a terminal velocity dive (Rolls Royce Kestrel engine).

Courtesy of Flight

Four British military models



Courtesy of Flight

In the November issue of AVIATION the American section of our series on the equipment of air forces of the world was brought to a close. We present herewith the first of two articles devoted to Great Britain. The author of the British division is already well known to readers of AVIATION as a frequent contributor and an outstanding authority on air tactics.

The equipment of air forces

GREAT BRITAIN (PART ONE)

By Maj. Oliver Stewart

IF A CURVE of progress in service aircraft in Great Britain were plotted it would show a series of violent fluctuations between extremely poor quality material and extremely good. From the early days of the War until the present time such fluctuations have continued, and while at one moment the quality of British service aircraft might descend below that of comparable air powers in other parts of the world, at the next it would rise above it. Thus at one period of the War of 1914 the Royal Flying Corps machines were outclassed by those of the enemy and were being shot down in such great numbers that there was an outcry in Parliament about it; while, later on, a definite ascendency in aircraft design was secured.

To search for the exact cause of these fluctuations would be fruitless, but they seem to be related in a general way to the degree of freedom enjoyed by the aircraft and aero-engine manufacturers. When the flying service takes it upon itself to dictate its needs to manufacturers in a highly detailed form and to insist upon those needs being met in detail, the result is usually a serious fall in aircraft performance. The machines become cluttered up with military equipment; with clumsy gun mountings, bomb sights, bomb racks, and a hundred and one odds and ends which the departmental officers believe to be essential. Moreover, extraordinary and sometimes conflicting demands are made for particular fields of vision for the pilot and gunner and particular kinds of fields of fire. But when, on the other hand, the aircraft designer is given a free hand the aircraft improves. This relation between designer and staff officer must be kept in mind if the ups and downs of British military air equipment are to be understood.

A word must first be said about nomenclature in the British air force. The single-seater fighters, which correspond to the pursuit ships in the United States services, are divided into the interceptors, which are dealt with fully later, and the high-altitude fighters. Two-seater fighters were abandoned after the war, but they have recently been reintroduced and one squadron has been equipped with Hawker two-seater fighters developed from the Hawker Hart bomber.

The day bomber class, as it is known in the British service, is a relatively small single-engined aircraft with a crew of two, carrying perhaps 500 lb. of bomb load. [Or about half the load required in an American light bomber.—Ed.] One other class of day bomber in use in the R.A.F. is the twin-engined Boulton and Paul Sidestrand, which has a crew of four and carries a bomb load of 1,000 lb. Its range is greater than that of the single-engined day bombers. The night bomber class is invariably twin-engined or three-engined. Troop carriers, or transports, are convertible to bombing service, and have two or four engines.

The R.A.F. inventory

A few general facts may now be rehearsed in order to form a frame within which the development of British service aircraft may conveniently be set. The general policy of the Royal Air Force has been to concentrate upon five main types of aircraft and to provide the equipment for the bulk of the squadrons from them. They are the single-seater fighters, the day bombers, the general purpose aircraft, the heavy bombers, and the flying boats. Besides these there are the army co-operation [or observation], and Fleet Air Arm [Naval] aircraft.

A full statement of R.A.F. equipment as it stands today, with the number of aircraft in each class, is as follows:

Single-seater fighters	156
Day bombers	336
General purpose	72
Heavy bombers	100
Flying boats	30
Army co-operation	120
Fleet air arm	156
Total in use Sept. 19, 1932	970

Of this total, 838 are first-line aircraft, and 132 non-regular second-line [obsolescent] aircraft, mainly machines of the day bomber, general purpose, and heavy bomber types.

In the past it has been the custom to modify a few basic types, such as day bombers, to create Army co-operation, Fleet spotter, photographic, reconnaissance, and float seaplane machines, and there is no present sign of any radical departure from this policy. The aim is to obtain the advantages of standardization and series production and yet to get a sufficient degree of specialization for each military duty. At the same time, there has always been in the British service a certain proportion of

the squadrons equipped with entirely specialized types. For instance, there is one squadron of twin-engined day bombers; there are torpedo carriers, and there are troop-carriers.

Procurement practice

All machines in the British service are of metal construction. Steel is used extensively, although the wing coverings are still of fabric in almost every type. Wood has entirely disappeared in the main structures of first-line aircraft. The policy of using steel is dictated principally by the facilities for obtaining and working it in England. Manufacturers are made to fall into line in the materials they use and in the military aims of their designs by the system of Air Ministry "specifications" which are issued to approved firms. These specifications correspond to the American "directives" and show what the service requires in performance and general qualities.

The system of supply in the Royal Air Force starts either with the issue of specifications or else with the building by any firm as a private venture of some new type aircraft and its presentation to the Air Ministry for test. The Air Ministry's moves begin with the examination of drawings fitted to their own specifications, and representing the solutions of the different designers to the problems of a particular type of military machine. When the Supply Department has selected the three sets of drawings which it considers to be the best, one aircraft of each of these three types is ordered.

The machines are built and are sent to the Armanent and Aeroplane Experimental Establishment at Martlesham Heath, where they go through a routine program of performance testing. Climbs and speeds at heights are done as well as consumption trials and partial climbs. There are also tests of handling qualities and of durability. The machine is flown as much as possible in the time available.

After Martlesham Heath one of the three machines may be eliminated by failing to come up to the requirements or for some other reason. If all three seem to show fairly even merit however, all three are sent round to service squadrons for "service trials." No precise program is drawn up for these service trials; but the general idea is that the aircraft is taken on by a squadron doing the kind of work for which it is designed, and is tried by the pilots and criticised by them. Reports are drawn up and collated by the Air Ministry.

By this stage a fairly accurate idea of the qualities of the three aircraft is obtained. Final conferences take place and the question of price and production is gone into more thoroughly. Then, when the sanction of the financial authorities has been obtained, the production order is placed for one of the types. Even when, as occurred with the Fairey Firefly and the Hawker Fury, both interceptors built for the defense of London, two of the machines appear to be about even in their military qualities as well as showing no marked differences in performance, it is not the custom of the Air Ministry to split up the order. One of the machines will be chosen and the production order will be concentrated on that type. No further examples of the other will be ordered.

Sub-contracting production orders

The system of supply, as it exists today, then, is a sequence of competitive sets of drawings, which may be submitted by twenty different firms, competitive trials, which will be between only three firms, and a production order. The production order, however, does not go necessarily to the firm that has originated the aircraft. It will be spread about the various firms of the industry, who will be asked to quote for producing the machine to the original drawings.

The specifications are issued to approved firms and, although there is no official ruling on the point, those firms usually include the twenty-odd forming the Society of British Aircraft Constructors. Without officially committing itself in any way, the Air Ministry is expected to support those firms and to see that their design staffs are maintained. Provided it can do so without impairing the efficiency of the service, it distributes its orders among them on as nearly an even basis as possible.

The object of this arrangement is to keep together the essential nucleus of skilled and experienced draftsmen and designers capable of dealing effectively with the rapid expansion of the service that would be necessary in a national emergency. Lately there has been some dissatisfaction with the way in which orders have been distributed and it has been suggested that too large a proportion of the total equipment of the R.A.F. will have originated in the Hawker drafting-rooms, with the result that originality and experiment elsewhere will be discouraged. On the other hand it is complained that, by farming out designs to a number of constructors, the brains of the originators are picked for others' benefit. [This practice of splitting up orders, taking part of the business away from the originator of the design, has not been tried to any great extent in America. It is generally regarded with a very hostile eye in the American industry.—Ed.]

It will be seen, therefore, that the British aircraft industry, relying as it does chiefly upon Air Ministry orders for its existence, must co-operate closely with the service and must be prepared to accept the conditions which the Air Ministry imposes upon it. That this arrangement tends to shift the source of design from the manufacturing firms to the officers of the Royal Air Force cannot be denied; and it is therefore a system which can readily be abused. Apart, however, from a redistribution of the air force between the army and the navy, it seems to be the only system offering a practical solution to the problems of supply.

It is true that firms in England can, if they so desire, build service aircraft to their own design and at their own risk, unhampered by the Air Ministry, such machines are known as "Private Venture" aircraft. Sometimes a machine which starts in this class will later be adopted by the Air Ministry and, as a matter of fact, some of the best service aircraft produced in England have been in the private venture class. [The Fairey Fox, with Curtiss D-12 engine, was an example.—Ed.] But the production of a private venture machine necessitates the gambling of large sums of money, especially if it comes in the largest class like the recent four-engined Vickers bomber, so that generally the firms are content to do what they are told and are averse to introducing any feature that is known to be frowned upon by the Air Ministry.

One or two general features of design of British service aircraft may now be remarked before passing to particular features. First is the acceptance of the biplane form. The arguments for and against the biplane for fighters and bombers are well known. The amount they influence an air force staff depends upon how much store that staff sets by the power of maneuver and by the use of small parts, with resultant simplification of spares service.

Good vision or good outlook, as it is more accurately called, has been claimed for both the monoplane and the biplane and it is probably true to say that it is in fact the prerogative of neither type. The power of maneuver of the biplane, however, has been shown to the satisfaction of R.A.F. pilots to be superior to that of the monoplane of comparable type and power. The greater wing span of the monoplane resists rolling more than the shorter span of the biplane. In night bombers the larger horizontal projected area of the monoplane makes it a bigger mark for searchlights.

Other reasons which have tended to make the monoplane unpopular in the British service are the difficulty of obtaining a structure which is entirely free from both flutter and buffeting under all conditions. The monoplane makes its appearance among the experimental aircraft of the British service at intervals, but it has so far never come into general use. The Royal Flying Corps was using the Morane Parasol monoplane fairly extensively in 1916, and the Morane Bullet was also used. Among

the British designs the Bristol monoplane of the early days of the War drew much attention and was favorably reported upon by test pilots. But it was not selected for general use because it was said that the outlook was too restricted.

The triplane and even the quadruplane forms have also been tried in the British service, the Sopwith triplane used by the British Royal Naval Air Service in 1917 being a beautiful aeroplane to handle in the air and having, for its day, a good performance. The latest and, apart from the D. H. Halford-Napier single seater, the only recent example of the monoplane form in Royal Air Force service aircraft is the Fairey twin-engined bomber with two Rolls-Royce Kestrel engines. The Fairey (Napier) long-range machine, although built for the R.A.F., is intended solely for an attempt on the long-distance record, and cannot therefore be included among the service monoplanes.

The Fairey bomber monoplane is still in the experimental stage and it remains to be seen if the Air Ministry will depart from precedent and choose this form for the heavy bombers. The Fairey is a particularly intersting machine and is of remarkably clean design while its performance is high for a machine of this class. It will have achieved a signal triumph if it succeeds in bringing the monoplane form into the standard equipment of the British service.

"Sort of bloomin' cosmopolouse"

As the general-purpose aircraft is supplied in greater quantity to the R.A.F. than any other type, it will be convenient to examine it closely. The type adopted by the R.A.F. is the Westland Wapiti, a machine which can be used either as a landplane or a float seaplane for bombing, reconnaissance, photography or other duties. If the genesis of this type be sought it will be found in the three war aircraft, the two-seater fighter, the day bomber, and the Army co-operation machine; or, to give them their names, the Bristol Fighter, the D.H.9a and the R.E.8. The Wapiti is a two-bay biplane of all-metal construction except for the big coverings. The engine is the Bristol Jupiter, while the replacement type of aeroplane brought out recently as a private venture by the Westland Company is fitted with the Pegasus engine of even higher (550) horsepower.

There are few more difficult problems before the designer than those presented by the general-purpose machine as it is visualized by the British Air Ministry. He must arrange not only for the normal two-seater accommodation according to military requirements of outlook and fields of fire, but also for such things as the prone bombing position for the observer, for radio apparatus, oxygen apparatus, emergency equipment, spares and rations and for the stowage of extra petrol, and "desert" equipment.

A comparison between the performance figures for the Bristol Fighter, the D.H.9a and the Westland Wapiti is instructive. I quote the figures secured at the R.A.F. test station at Martlesham Heath.

Bristol Two-Seat Fighter (1917)

(*Rolls-Royce Falcon III*, 250 hp.)	Lb.
Weight empty	1,750
Load per sq.ft.	6.92
Weight per hp.	10.6
Disposable load apart from fuel	630
Total loaded weight	2,800
Speed at 10,000 ft.	102 m.p.h.
Speed at 15,000 ft.	88 m.p.h.
Climb to 10,000 ft.	17.5 min.
Climb to 15,000 ft.	42 min.

D. H. 9a (1918)

(400-hp. *Liberty*)	Lb.
Weight empty	2,656
Weight loaded	4,815
Load per sq.ft.	9.89
Weight per hp. fully loaded	12.8
Speed at 10,000 ft.	114 m.p.h.
Speed at 15,000 ft.	106 m.p.h.
Climb to 10,000 ft.	15.8 min.
Climb to 15,000 ft.	33 min.

Westland "Wapiti" (1931)

(*Bristol Jupiter VII F*, 450 hp.)	Lb.
Weight empty	3,810
Disposable load	2,220
Weight loaded	5,400
Speed at 10,000 ft.	136 m.p.h.
Speed at 15,000 ft.	129 m.p.h.
Climb to 10,000 ft.	9.5 min.
Climb to 15,000 ft.	17.5 min.

It will be noticed that the general-purpose Wapiti, which carries a large amount of equipment, climbs to 15,000 ft. in the same time that the war-designed Bristol Fighter,—by general consent one of the most notable aircraft the War produced,—took to climb to 10,000 ft.

Although the performance of the general-purpose machine shows a notable advance upon comparable types of earlier date, the single-seater fighter, which is the R.A.F. name for the pursuit class, shows much more notable advances. But here some remark must be interposed about the nomenclature of the single-seater class in the R.A.F. There are the "high altitude" fighters and the interceptor fighters. The interceptors, as has been mentioned on many occasions, are primarily intended for the defence of London. They have great powers of climb and a high speed, being capable of 214 m.p.h., but their endurance is not great. The "high altitude" fighters would be better called general-purpose fighters, for they are intended for all the normal fighting work over a wide range of altitudes and including night fighting. Escort work for bombers is not given any separate recognition by the British Air Ministry, for it is assumed that all aircraft can look after themselves; but if, as is highly probable, escorts were found to be essential in a real war, the high-altitude fighters would be called upon to do them.

The existing standard fighters in the R.A.F. are the Hawker Fury and the Bristol Bulldog. The Fury appears in a slightly different guise under the name of Nimrod for fleet work. It has larger wings and is modified for deck landing and for catapulting. Essentially, however, the Nimrod is the Fury and can be treated as such for purposes of comparison.

The type of single-seater fighter selected for the R.A.F. immediately after the War and used in large numbers was the Sopwith Snipe. Its Martlesham performance figures were:

Sopwith Snipe

(*B.R.2*, 220 hp.)

Total loaded weight	2,020 lb.
Gasoline tank capacity	38½ gal.
Oil tank capacity	7 gall
Speed at 10,000 ft.	121 m.p.h.
Climb to 10,000 ft.	9.4 min.
Speed at 15,000 ft.	113 m.p.h.
Climb to 15,000 ft.	18.8 min.

The modern Hawker Fury has the supercharged Kestrel engine (700 hp.) and its top speed is 214 m.p.h. at 15,000 ft. and 204 m.p.h. at 20,000. The Fury climbs to 20,000 ft. in nine minutes 40 seconds, so that it will be seen that it reaches in a given period of time almost twice the height of the Snipe and that including the climb between 10,000 and 20,000 ft.

The Bristol Bulldog is at present more widely used than any other type of single-seater fighter in the R.A.F. Its performance figures are:

Bristol Bulldog

(*Jupiter VII*, 450 hp.)	Lb.
Weight empty	1,987
Weight loaded	3,250
Speed at 10,000 ft.	174 m.p.h.
Speed at 20,000 ft.	167 m.p.h.
Climb to 20,000 ft.	14.5 min.

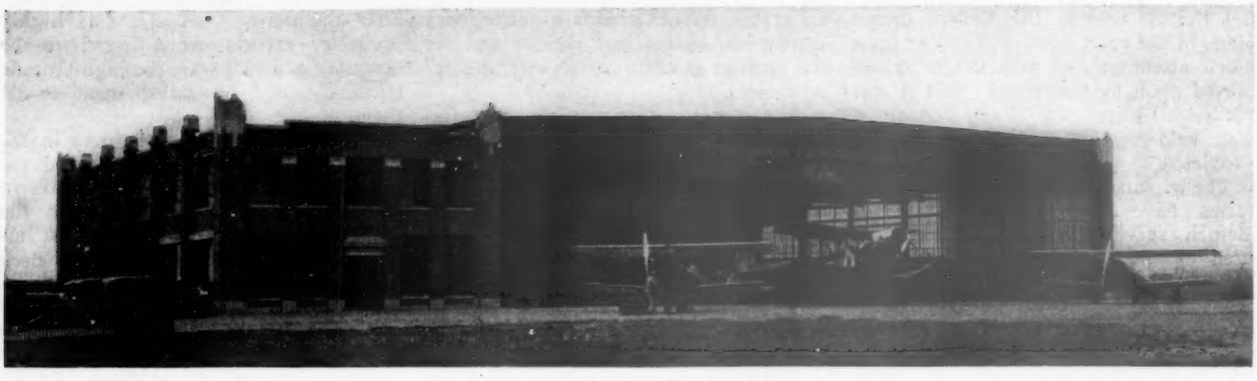
It may be of interest to compare these figures with those for the single-seater fighter type that immediately preceded the Bulldog and the Fury; that is the Siddeley Siskin.

Siddeley Siskin

(*Jaguar, Supercharged*)

Speed at 10,000 ft.	153 m.p.h.
Speed at 15,000 ft.	149 m.p.h.
Climb to 10,000 ft.	6 min. 21 sec.
Climb to 15,000 ft.	10 min. 36 sec.

In a subsequent article some consideration will be given to the efforts that have been made to provide good powers of maneuver in R.A.F. aircraft and to ensure good maintenance conditions. The individual types will be examined further, and the day and night bombers and the specialized types will be considered.



T.A.C. repair base at Pontiac, Mich.

Transport servicing for private flyers

Notes on Thompson Aeronautical Corporation's facilities for servicing Transamerican Airlines' ships and those of private owners and other operators in the Great Lakes region. The eighth of a series of articles on transport maintenance.

By
S. Paul Johnston
Assistant Editor of AVIATION

IN THE CASE of all the airlines so far studied in the present series of articles on maintenance, it has been apparent that the shops and servicing facilities have developed as a necessary adjunct to the flying schedules. Operations come first, maintenance second, and with the exception of certain engine shops, such as those of United Air Lines at Cheyenne and Chicago which are authorized Pratt & Whitney repair stations, the airline maintenance shops limit their activities to their own requirements, and do not solicit work from customers outside their own organization. The relationship between Thompson Aeronautical Corporation and Transamerican Airlines, however, is radically different, for the former, an airplane and engine servicing concern, is the parent and holding company for the operating subsidiary;—the maintenance functions antedated the airline. Thompson Aeronautical Corporation exists not only to keep Transamerican equipment in flying condition, but, to an equal if not greater degree, to make transport grade servicing available for the private and industrial airplane owner in the Great Lakes territory.

The company owns and operates two major airplane and engine overhaul bases, one at Pontiac, Mich., and the other at Cleveland. Servicing hangars are also maintained at Detroit, Chicago, South Bend, Kalamazoo and Bay City. All overhaul work for Transamerican Airlines is carried out at the Cleveland or Pontiac terminals, but all stations are fitted up to give routine servicing, and to distribute certain standard aircraft parts. The scope of the work at each station is well indicated by the sales service chart which is reproduced herewith. This chart is of primary interest to the private or industrial owner, but it indicates also the ability of the various T.A.C. stations to serve the airline's ships as required.

The Pontiac base holds Department of Commerce Approved Station Certificate No. 131 and is said to be the only station in the country covering all makes of engines used on transport lines,—Wright, Pratt & Whitney, Kinner and Lycoming. A modern brick and steel hangar with attached buildings offers adequate storage space for the airplanes, and houses the offices and shops. The lean-to on one side is a two-story affair. The first floor from front to back houses the operating offices, stockrooms, engine shop and motor-test house. The second floor houses offices, radio and instrument shop, and wing loft or fabric shop. Welding and sheet metal working operations are confined to a fireproof semi-detached wing behind the main hangar. Propeller overhaul and battery charging are taken care of in the hangar proper.

The Cleveland base holds Department of Commerce Approved Station Certificate No. 143, and is equipped to handle virtually the same work as at Pontiac, with the exception of Lycoming engines and Pioneer instruments. Equipment is on hand to take care of all maintenance operations, both on planes and engines. The extent of the engine overhaul facilities is indicated by the fact that cylinder finishing equipment includes not only Heald grinders, but also a Hutto cylinder honing machine. Cylinder grinding equipment is found in many airline overhaul shops, but honing tools are usually confined to manufacturing plants. Complete testing equipment is on hand for carburetors, magnetos, starters, generators and spark plugs. The Cleveland station is one of the few shops in the country now authorized to make major repairs and adjustments on autogiros.

The executive personnel of Thompson Aeronautical Corporation and its subsidiary, Transamerican Airlines, is identical. Both are under the presidency of R. C. Marshall. John L. Ruden, with headquarters at Detroit, functions as vice-president in charge of

operations. The Pontiac base is in charge of Benjamin F. Hawkins, and J. W. Borton heads up the activities at Cleveland. Divisional or terminal managers are assigned to the several intermediate fields where servicing stations are located.

Turning now to the operating subsidiary,—Transamerican Airlines Corporation is engaged in the transport of passengers, mail and air express in an area roughly triangular in shape, extending from Chicago to Cleveland, and to Bay City, Mich., in the north. Recently, additional schedules have been inaugurated, connecting Detroit with Buffalo. During the summer months (April 1 to Oct. 1) direct ferry service on amphibions is offered between Detroit and Cleveland across Lake Erie. All other schedules are conducted with land-type machines. Besides the four Cyclone-powered Loening amphibions used on the Cleveland-Detroit run, the equipment inventory at the present time consists of four Lycoming-powered Stinson SM-6000 three-engined machines; five Whirlwind Stinson SM-1's; a Wasp Stinson SM-6B; a Wright-powered Model 4AT Ford; two Wasp-powered Fokker F-10A; five Whirlwind-powered Pitcairn Mailwings; one Wright-powered Travelair, and one Waco. An announcement has recently been made that in the early part of 1933, the fleet will be augmented by four of the new Cyclone-Curtiss Condor transports. These machines have actually been ordered, and options have been taken on two more of this type.

Flying schedules are so arranged that all equipment passes through Cleveland or Pontiac bases at least once every other day. Wasp powered Fokker F-10's used between Cleveland and Detroit are taken care of at Cleveland. The work required at this point to keep the three daily schedules to Detroit in the air is not excessive so that the greater part of the capacity of the Cleveland base is available to outside customers. A greater number and a greater variety of equipment passes daily through Pontiac, so that the proportion of purely company business in these shops is somewhat greater than at Cleveland, but the present capacity of the station is such that demands from outside sources may be met with promptness and dispatch.

In accordance with good airline practice, definite schedules have been set up for the overhaul of all flying equipment. Flying time is posted daily from the log books, and engines are changed, or airplanes withdrawn from service when the established time limits have been reached. The Ford, Fokker, and Loening equipment is sent to the shop for overhaul every 1,000 flying hours; the Stinson single-engined machines go through overhaul at 1,500 hours; and Pitcairn Mailwings and Stinson trimotors are scheduled for overhaul at 2,000 hours. Wright Whirlwind J-5's and Wright Cyclones are pulled for overhaul at 300-hour intervals. The Wright Whirlwind J-6's, the Pratt & Whitney Wasps, and the Lycomings come out every 350 hours.

Careful records have been kept of overhaul time on all types of engines in use on the line, and the average labor-hours required for complete overhaul, including carburetors, magnetos, starters, generators and run-in, are given in the following table:

	Man-hours
Wright Whirlwind J-5	135
Wright Whirlwind J-6	140
Lycoming	120
Pratt & Whitney Wasp	140
Wright Cyclone	175

These figures are averages, and are therefore only approximations for any particular case. Some variations occur, which are largely a function of the total life of the engine, and the number of parts which must be replaced at any given overhaul.

Propeller overhaul time does not correspond exactly with engine overhaul time. The three-bladed propellers for the Cyclones and the Wasps are removed for overhaul at 250-hour intervals. Two-bladed Wasps and two-bladed Wright Whirlwind J-6 propellers are removed every 300 hours, and the two-bladed propellers for the Lycomings and the Wright J-5's at 350 hours.

All propeller blades are etched at every overhaul. Equipment for balancing and tracking propellers has been maintained both at Cleveland and Pontiac. The etching is done by the Ford Motor Company at Dearborn, although equipment is now planned for Pontiac. The normal procedure in propeller overhaul consists of disassembly, checking the hub for defects with a microscope, etching the blade in the usual manner, and subsequent thorough inspection for cracks, flaws, etc. Minor damage is worked out with file and crocus cloth, but if microscopic examination indicates that cracks or dents are deep, blades are immediately discarded. The final operation is a thorough polishing, after which parts are reassembled, and the pitch checked at a number of stations along each blade.

A number of interesting and useful gadgets have been developed, and are in use in the Thompson shops. Portable work benches, completely equipped with tools for various purposes; engine cylinder racks and pedestals for overhauling valves and valve gear; light and sturdy servicing platforms and portable lighting fixtures, and an ingenious universally adjustable engine stand represent the many items of this sort in use. Among these devices is one that points toward an idea which will undoubtedly be the subject of careful study on the part of designers in the next few years,—the demountable power plant. At Pontiac, stands have been built to take complete wing or nose engine mounts for the Lycoming-powered Stimson tri-motors. The engine and the mount are completely assembled

SALES SERVICE CHART

Thompson Aeronautical Corp.

AUTHORIZED PARTS-SERVICE — **24-HOUR BASE SERVICE**

Parts—Service Available At T. A. C. Stations →	*CLEVELAND	*PONTIAC	CHICAGO	DETROIT	KALAMAZOO	So. BEND	BAY CITY
Gas—Oil—Storage	X		X		X		
Motor Checks	X	X	X	X	X	X	X
Major Engine Overhaul—Parts							
Wright Engines	X	X					
Pratt & Whitney Engines	X	X					
Kinner Engines	X	X					
Lycoming Engines		X					
Minor Plane Repairs	X	X	X	X	X		X
Major Plane Overhaul	X	X					
Engine Accessories—Service							
Stromberg Carburetors	X	X	X	X	X	X	X
Scintilla Magnetos	X	X	X	X	X	X	X
Eclipse Starters	X	X	X	X	X	X	X
B. G. Spark Plugs	X	X	X	X	X	X	X
Packard Cable	X	X	X	X	X	X	X
Instruments—Repairs							
Pioneer Instruments		X					
Instrument Service	X	X	X	X	X	X	X
Plane Accessories							
B. F. Goodrich Tires	X	X	X	X	X	X	X
Aircraft Products	X	X	X	X	X	X	X
Berry Bros. Dopes, Lacquers, Finishes	X	X	X	X	X	X	X
Nashawena Fabrics	X	X	X	X	X	X	X
Exide Batteries	X	X	X	X	X	X	X
Irvin Chutes	X	X	X	X	X	X	X
American Optical Goggles	X	X	X	X			
Bolts, Nuts, Miscellaneous	X	X	X	X	X	X	X

*Stations with machine shop facilities.

"Serving YOU in the Great Lakes Region."

Printed in U. S. A.

TAC service chart showing work which can be done at each station.

on the stand, and the final installation on the ships consist merely of swinging a complete assembly (except for cowling) into place, the insertion and tightening of a relatively few supporting bolts and the connecting up of the controls. The idea is not wholly new, for nacelle assembly jigs have also been put in use at the American Airways shops in Dallas for Fokker F-10's, and in the Pan American shops at Brownsville for Fords. There are still many difficulties to be overcome before a practical solution is available, but it is not too much to expect that in the near future complete airplane power plants can be made interchangeable in the same fashion that certain motor-bus engines are today. In some bus maintenance stations engine changes require incredibly short time, a matter of minutes only, and developments of the sort mentioned above point toward the possibility of similar attainments in the aircraft field.

Transamerican Airlines storage battery practice differs slightly from that of some of the other lines. Generally speaking, batteries in transport airplanes are removed and put on charge on the average of once a day, regardless of the actual condition of the battery. Thus on ships which fly a schedule long enough to consume the better part of a day, the battery is put in fresh at the point of departure, and removed at the terminus,—a fresh battery being substituted before the airplane returns to its base. All terminal stations are usually equipped for battery charging, and the batteries are in constant circulation. On the average, a battery may be one day in the air and one or two days on the ground undergoing charging or storage. The Exide and Willard storage batteries on Transamerican are handled on a schedule which varies somewhat, depending on whether or not the ships in which the batteries are placed are equipped with generators. Those airplanes (Pitcairns and single-engined Stinsons) which have no generators, have their batteries replaced and charged every day. Batteries in service on ships with generator equipment (Fords, Fokkers, Stinson tri-motors and Loenings) are inspected daily, but are not removed for a bench charge unless the tests indicate the battery is in need of attention. The relative merits of the two methods of handling batteries can be determined only on a cost basis. With the type of service to which their batteries are subjected, Transamerican reports that the average battery life is about six months.

Dope room fires

THE fire hazard involved in handling dope in airplane repair shops has long been recognized, but in spite of elaborate precautions, fires occasionally break out without warning in even the most modern shops. A case in point was reported in the Navy Department *News Letter* No. 287 dated Sept. 1, 1932, describing a fire which occurred in the dope room of the Naval Air Station at Norfolk, Va., on June 24 of this year.

The shop is of modern concrete and steel construction, and is ventilated through two ducts taking air through floor gratings to blowers outside the building. The air speed in the ducts is about 14 m.p.h., and the blowers have enough capacity to give a complete change of air in the dope room in a little over one minute. With such complete ventilation it is difficult to see how sufficient gases could accumulate to support combustion. For some reason, however, fire broke out under the floor gratings from which it spread rapidly to two airplane wings standing in racks nearby. Prompt action on the part of the shop personnel and the automatic sprinkler system brought the flames under control, and limited the actual damage to the two wings.

A board of investigation made certain recommendations which should be of interest to anyone connected with the doping of airplane surfaces. There were three probable causes assigned—first, ignition from a lighted match or cigarette (in spite of a rigid rule against smoking in the shops), second, a piece of sand paper may have struck the exhaust fan blades, causing a spark that ignited the gases in the ducts, and third, a spark may have been caused by a shoe nail or a tool dropped on the concrete floor or on the gratings. It was recommended specifically that all gratings be replaced with non-metallic material, and equipped with screens to keep foreign matter from dropping into the ducts; that a non-sparking fireproof floor be installed; that smoking be prohibited within 50 feet of the shop, and no smoking materials be allowed in the shop.

Since freshly doped surfaces are good insulators, a great deal of static may be developed by friction, and it is therefore necessary that all supporting members for doped parts be thoroughly grounded. Motors driving fans should be kept outside of the dope rooms and should be of the squirrel cage type. Motor frames and all paint-spraying equipment should also be electrically grounded. Dry sanding is a source of static electricity, and should never be attempted when dope fumes are present. In addition, the obvious precautions should not be neglected. The minimum possible amount of dope should be kept in the shop at any one time, and the rule prohibiting smoking should be rigidly enforced.

Left: Stinson nacelle and Lycoming engine on Thompson Aeronautical shop assembly rack. Right: Nose engine for Stinson showing detachable mount.

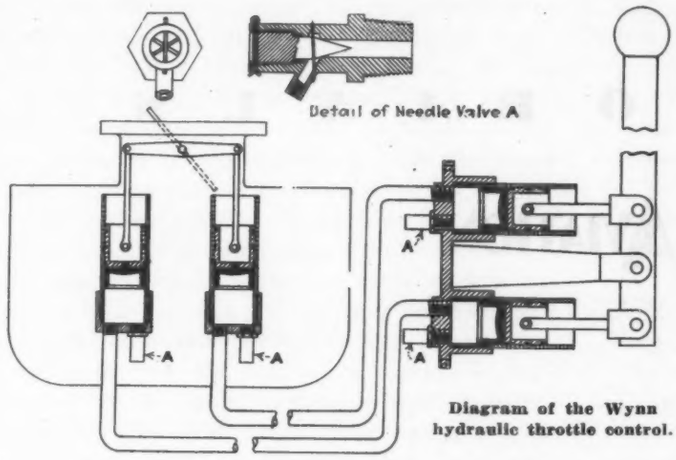


Diagram of the Wynn hydraulic throttle control.

Estimated total weights of Wynn control (three-engines)

Master unit filled with fluid	3 lb., 2.4 oz.
78 ft. of ¼-in. O.D. copper tubing filled with fluid	7 lb., 5 oz.
Three separate operating units filled with fluid	2 lb., 13.4 oz.
Entire system ready for operation	13 lb., 5 oz.

Estimated total weights of mechanical control (three-engines)

39 ft. of mechanical control	9 lb., 12 oz.
Hand lever unit	2 lb., 8 oz.
Entire system ready for operation	*12 lb., 4 oz.

**Plus 1 to 3 lb. of bell cranks and fittings in some cases*

Hydraulic throttle control

THE ordinary aircraft throttle control system usually involves a number of push-rods, bell-cranks, and springs. For a three-engined installation, it is quite a problem to design an efficient control particularly for the outboard engines, for, due to the large number of joints and bearings required, the slightest wear is amplified, making it difficult to avoid sloppiness and the consequent lack of precision in throttle adjustment. Troubles from this source become apparent when precise synchronization of three engines is attempted.

Believing that further improvement is possible, J. H. Wynn of Gary, Indiana, has designed and has test-flown a radically new type of throttle adjustment, which offers interesting possibilities for the control of outboard engines. The outline drawing shows the operating principles of Mr. Wynn's scheme. The throttle lever in the cockpit is connected by suitable linkages to a pair of plungers operating in two small parallel cylinders. As indicated, the lever arms are so arranged that as one plunger moves inward in its cylinder, the other moves outward. The butterfly valve at the carburetor is linked up through a yoke to a corresponding pair of cylinders. Copper tubing connects each carburetor cylinder with one of the throttle control cylinders. When each cylinder and tube is completely filled with a non-compressible, non-freezing fluid (No. 5 Lockheed Hydraulic brake fluid, for example), it is obvious that an angular displacement of the throttle lever will produce a corresponding angular displacement of the butterfly valve. Each cylinder is fitted with a bleeder valve of the needle type (A) to permit filling of each leg of the system completely without inclusion of air bubbles. A supply tank and pump are used to fill the system on the ground, but are not necessarily carried on board the ship. Rubber cup packings prevent leakage in the aluminum cylinders.

The two hydraulic elements of the system are completely balanced at all times, and are under no pressure to cause leakage. If necessary, the system will still continue to function with one of the hydraulic connections completely broken. Sufficient vacuum can be attained in the operating cylinder, so that a movement of the lever in either direction can be obtained under an emergency condition of this sort.

Calculations indicate that the Wynn system may be installed on an average three-engined airplane at a total weight of about the same as the mechanical system which it replaces. For a typical installation the comparative weights of the Wynn and the lightest available mechanical control are given in the tabulation at the left.

The weights given above represent the system in its present stage of development. It is felt that further weight reductions can be accomplished by certain refinements in design. For example, the weight schedule is based on separately mounted operating units, whereas the ultimate construction will probably involve units built integral with the carburetor, resulting in some further saving.

Furthermore, the functioning of the Wynn system is independent of the shape of the interconnecting tubes, so that sharp bends can be made to get around corners in place of the large radius bends, or the complicated system of bell-cranks and mountings required in other systems.

The Wynn hydraulic control has been flown for some hours in a single-engined airplane, and arrangements are now being made to apply it to a tri-engined installation for thorough test.

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Welding hangar floor

THE *Electric Journal* for October, 1932, reports an interesting welding job in the new Navy hangar being constructed at Sunnyvale, Cal., to accommodate dirigibles of the Akron-Macon class. Because it is sometimes necessary to drag the fragile helium containers over the floor, a perfectly smooth surface without protruding bolt or rivet heads was required. Steel plates ¼-in. thick were laid over a suitable foundation, and were welded together in place along their adjoining edges.

After the welding, the plates were ground down and seams polished until the entire area was so smooth that it was difficult to detect where the joints occurred. Over 30,000 sq.ft. of floor was paved in this manner, the job requiring about 40,000 lin.ft. of electric arc-welding.

EDITORIALS

AVIATION
EDWARD P. WARNER, *Editor*

Selling air transport is *everybody's* job

THE readers of AVIATION, without exception, have a deep personal interest in the prosperity of the aeronautical industry, from which a very large proportion of them actually draw their livelihood. Fortunately, their interest need not be a quiescent one. You need not wait for prosperity to be handed to you on a silver platter. You can go out and create it for yourself.

Air transport is the new backbone of the industry. It is air transport that is stiffening the whole structure. If we want to promote the success of aircraft factories, or of any kind of aërial operation, the most important thing that we can do is to work for an increasingly rapid public acceptance of travel by air, and in that every one of us can take a hand.

We may not all have the opportunity of giving sales talks on air travel. Some of us may be so lacking in the gift of salesmanship that we would be of little service in that connection in any case, but whether or not we can take a positive part in the development of traffic, we can at least refrain from taking a negative one.

Air transport has cleared its first hurdle. Its existence is generally recognized. Almost everybody now knows that it is possible to travel from one city to another more quickly by air than in any other way, and at a cost not much exceeding that of the railroad journey. What operates to keep people out of the air now is not so much ignorance of the service that is being rendered as fear, suspicion, uncertainty, and inertia. Those factors will pass of their own accord if they are given nothing to feed upon. It is the proper job of the people actively interested in aviation,—and that goes not only for those in the employ of the transport companies, but for draftsmen, airport managers, private pilots, and a whole lot of others,—to see that suspicion and its ugly brethren are deprived of nourishment.

OBVIOUSLY, nothing will create suspicion so effectively as a feeling that aeronautical operations are haywire improvisations by carefree young extemporizers. There was a time when there was some reason for such a feeling in connection with many air transport operations, but it has long since passed. If you want to know how completely it has passed, turn to AVIATION of three years ago, and read an article by F. W. Wead, entitled "Air Transport From the Passenger's Point of View." It was a tale of hair-raising adventures resulting from harebrained methods. At the time when it was published it was a fair and conservative story of what still occasionally went by the name of air transport. Only three years have passed, and already it reads like a tale from another world, so utterly remote is it from present-day experience.

So far the work has been well done, but the potential customers of air transport do not always discriminate. They do not realize the difference between transport personnel on duty and transport personnel enjoying their leisure. They do not even distinguish between air transport companies and a thousand miscellaneous operators. The public judges the aviation business and the people in it as a whole, and the public's point of view toward air transport over the next two or three years is going to depend very largely upon what kind of people seem to be in the aviation business, and how they seem to behave.

THE writer of this editorial once owned a motorcycle. He bought it from a local dealer who was a jovial person with a host of friends, generally acclaimed to be "a great guy and a swell salesman."

About a week after the machine had been sold, and while it was still being garaged in the dealer's shop, the great guy amused himself one evening by interchanging the ignition wires on the magneto so that each cylinder fired at the end of the exhaust instead of the compression stroke. Then he stood around making pleasantly idiotic suggestions while the proud but somewhat ignorant new owner struggled in vain to get the machine started. It was a good joke, and the victim was able to laugh along with the spectators, though somewhat faint-heartedly, when it was explained to him. It was a good joke, and that particular dealer soon went out of business. There were a lot of people just like him in the motorcycle business, which is one reason why it has gone so extensively on the rocks. His case is worth bearing in mind as a horrible example. A few wild pilots, or a small number of aeronautical people with eccentric habits and misplaced senses of humor, can do more harm to air transport than the most skillful salesman can counteract in a year. If a sober citizen gets it into his head that airplane pilots are likely to be silly practical jokers or irresponsible victims of adult infantilism, it is going to be a difficult matter to convert him to air transportation.

THERE are some 18,000 airplane pilots in the United States, and they are all kinds. Most of them are self-respecting gentlemen with a sense of having entered upon a dignified profession; some of them are not. Every one of them has the prosperity of air transport in his keeping in some measure. Every one of them ought to bear that in mind, and to be reminded of it as often as necessary. If the pilots who are out of work now want to get jobs, or if those who already have jobs want to get better ones, it is very much in their interest to help air transport grow. They can do it by maintaining a personal appearance and a standard of behavior, both in the air and on the ground, which will command the respect of those with whom they come in contact, for if the captain of industry who ought to be traveling by air feels respect for the aeronautical people that he sees, he cannot help feeling respect for the aviation business itself.

Flying boats to French Frigate

ALMOST unhonored and unsung, a Navy patrol squadron attached to the Pearl Harbor Air Station has recently staged a flight that may open a new era in American high-seas aviation. Six flying boats have cruised in formation from Pearl Harbor, a few miles west of Honolulu, to French Frigate Shoals. They landed at French Frigate, stayed over night, and took off again the next day and came back home. The distance was only 500 miles. The speed was only 85 m.p.h. Compared with the exploits of Frank Hawks, Doolittle, or Post and Gatty it sounds an uninspiring performance, but it was the symbol of a new idea.

Take the largest atlas that you can find, open it to the map of the Pacific, and look for French Frigate Shoals. It may not be there. Little more than a coral reef awash in a boundless ocean, it was beneath the notice of many of the map-makers. The charts show it only as a spot upon which a ship might run aground. Yet it has become an aeronautical landmark.

American political and naval interests lie largely in the Pacific. Flying boats will never have attained their majority in the Naval service until they are able to operate freely over the Pacific. Up to the present time all of our flying-boat operations have been essentially coastal in nature. The patrol squadrons have worked out of Key West and Guantanamo and Coco Solo to scour the Caribbean. They have operated along the Pacific Coast of the United States and Central America and within the main group of the Hawaiian Islands, but they have never yet really struck out across the sea under service conditions. The NC boats made a beginning in 1919 with a transatlantic flight, but it was never followed up. There was another trial in 1925, when the PN's set out from San Francisco for Hawaii, but that was a stunt and not a wholly successful one. In the meantime, the flying boat squadrons of the R.A.F. have been probing the comparatively sheltered seas of the Eastern Hemisphere, and even reaching out into the Pacific as far as Australia and the Philippines. Von Gronau has repeatedly crossed the North Atlantic, and finally completed a leisurely jaunt by flying boat around the world. Most spectacular of all, the Italian Air Force, after years of preparatory cruises on a more moderate scale, have flown a squadron of boats from Chile to Brazil by way of West Africa. The time has long been ripe for the American Navy to undertake oceanic flying-boat cruises of its own, by squadrons or even larger groups.

THE flight to French Frigate, small in itself, is a beginning. Beyond French Frigate lies Midway, and then Wake, and then Guam, and then the Philippines, all of them under the American flag and with no hop of over 1,600 miles to separate them. To the south of the Philippines is Australia, and then to the east, at distances of 1,500 miles or less, come the new Hebrides, the Fiji group, and, getting back on to American soil, Samoa, Palmyra, and once again Hawaii. The Southwestern Pacific could be circumnavigated in 16,000 miles. The patrol squadrons would have gained a new experience, given their equipment a new test, demonstrated an ability which we fully believe that they possess to operate over distances hitherto

undreamed of, and, last but by no means least, a new inspiration would have been furnished for trans-oceanic air commerce.

We believe that the organization of regular flying boat service on half a dozen routes like that between Jamaica and the Canal Zone, upon which Pan American has been keeping its Commodores busy, but longer and more difficult, is a matter of the very near future. The pioneering work goes slowly because of the enormous cost of developing the equipment, proving it out and organizing the route. Nothing could be more helpful in stimulating American air transport over the open sea, or more helpful to the American industry in finding foreign markets for American-built flying boats, than a really spectacular squadron cruise by the Navy. With the interest of naval aviation, of the manufacturing industry, and of air transport operators all in accord, it ought to take only a very little time to get into action.

We hold no brief for the special itinerary that we have suggested. There may be better plans than a Cook's Tour of the Southwestern Pacific. A squadron flight from California to Hawaii might be better, but *some* itinerary should be selected and *some* flight made which will be as dramatic an event and as spectacular a proof of the qualities of material and men as was the American Fleet's cruise around the world 24 years ago.

New activities, new income

WHEN a man finds that the amount of business that can be done in his line is shrinking, he has only three alternatives. He can, up to a certain point, stick the knife into expense in an effort to keep the margin of profit the same as before. He can reconcile himself to the current state of affairs, and to accepting a smaller income than in the past. Or he can go out looking for some new kind of business to supplement the old, and to build his gross turnover back to its former dimensions.

The first possibility is limited. Most men accept the second, and their own standard of living goes down with the volume of their sales. A few, however, take the third course, and during the present depression it has been more popular than ever before.

News stands are selling orange juice, and soda fountains are taking orders for telegrams. Drug stores are selling sporting goods. Stationery stores are selling groceries, and grocery stores are selling tires and lubricating oil. Retail merchandising has become a giddy ring-around-the-rosy which ends up with plenty of excitement and confusion, but with no real profit for anyone. There are a few cases, however, in which the broadening of activity is not only permissible but exceedingly wise, and the operation of airplanes is among them.

A FEW years ago there were airplane dealers who did nothing but sell airplanes, or at least try to. There were repair shops that handled only maintenance work. There were operators who did nothing but photography, and there were others who did nothing but cross-country charter service, and who scorned "hop-flying." There were specialists in dusting, and specialists in advertising. Some of them are still specializing, and a few of them are making a really good living, but they are in the minority.

Under present conditions it is an extraordinary case in which a single type of flying will bring enough gross income to return the net profit to the owner which a man of the capacity required to operate a flying service is entitled to expect. There are several hundred small airports in the United States, each with its one or two operators. In not one case out of ten have the small-town flying services really explored the limits of their own possibilities. They offer to do one or two special types of work. If they are asked to take on anything else they are usually willing to try it, but it is their job to go out and sell the service themselves, instead of waiting for a customer to come in and tell them exactly what he wants and insist on their giving it to him.

There is hardly a city in the United States of 10,000 population or more where aerial advertising couldn't be used to occasional advantage. There certainly isn't a single community that doesn't hold out prospects for air photography, and while there are a great many pilots who are unskilled in the photographic art, every village has its local professional or enthusiastic amateur snapshotter, quite ready to go into partnership with the airplane owner and to supply the camera and do the photographic work.

We might in fact, use up a page in listing the things that are waiting to be done wherever there are airplanes, but it would be a waste of space, for we are giving just such a list every month in the department called "Airplanes At Work." Take up the last half-dozen issues of AVIATION and read over that department, and let your imagination work upon the uses for airplanes that you find listed there. If you will make a real effort to apply them to your own case, or to develop them into others that can be applied to your own case, and if you have been one of those operators who has resigned himself to having no income except a little passenger-carrying at week-ends, we shall be very much astonished if you do not succeed in doubling your gross revenue and considerably more than doubling your net profits.

NEWS OF THE MONTH

Cord fights Aviation merger

A CIVIL WAR is raging within Aviation Corporation. Hostilities were opened by E. L. Cord, largest stockholder, when the management made its first move toward acquiring a large part of the assets of North American Aviation, Inc., and, eventually, of Transamerican Airlines. They proposed to issue about 1,997,000 shares of Aviation Corporation stock in exchange for properties which include Eastern Air Transport, Sperry Gyroscope, B/J Aircraft, as well as a 26 per cent interest in Douglas Aircraft, a similar interest in Transcontinental & Western Air and a 10 per cent interest in Curtiss-Wright Corporation. Acquisition of Eastern Air Transport would give Aviation Corporation an alternative route for its transcontinental planes when weather conditions are unfavorable on northern lanes, and a link with Pan American Airways. Such an increase in outstanding stock to 4,977,000 shares would reduce the holdings of the Cord interests, now 25 or 30 per cent of the total, to about 17 per cent. The proposition was to have been submitted to the Board of Directors and, upon their approval, to the stockholders of the company at the annual meeting early in December.

To block the deal, which he opposed on the grounds that it is not to the best interests of either company, Mr. Cord secured a temporary injunction restraining the directors of the corporations concerned from acting on the transaction. Simultaneously his representatives requested that a stockholders' meeting be called for Dec. 21 to increase the directorate from 35 to 68 (from which number it had been reduced last spring), giving the Cord and other minority interests an opportunity to elect 33 new directors through whom they might control the concern. Campaign activities in both camps center on securing the proxies of the 28,000 inarticulate stockholders.

Last word from the front line is that upon petition by Aviation Corporation the Delaware Court of Chancery has dissolved the injunction restraining the directors of the company from discussing the deal with their stockholders upon condition that the directors' meeting, scheduled for Nov. 15 and from which legal obstruction is now removed, be postponed a week to give Mr. Cord and another director now on the West Coast the opportunity of being present when the proposition is discussed.

Both injunctions and proxies sought in public appeals to stockholders figure largely in United's battle with National Air Transport in 1930 when the New York-Chicago run was needed to complete its transcontinental line. N.A.T. directors, however, were opposed to the merger.

Records at home and abroad

From Ottawa to Mexico City, via Washington, was barely half a day's trip for James Wedell on Oct. 23 when he made a new record for the three-capital flight. Landing at the mile-high Mexican Airport eleven hours and 53 minutes after his departure from the Canadian capital, he bettered by 43 minutes the record Major James H. Doolittle had made almost exactly a year before. This included a fourteen-minute stop at Washington to take aboard 120 gal. of gasoline, and a brief landing at his home town at Patterson, La. Major Doolittle refueled at Birmingham, Ala., and at Corpus Christi, Tex., as well as at Washington. Powered with a Wasp Junior engine supercharged to about 550 hp., Wedell's crimson and black racer was of his own design and construction, and veteran of the 1932 National Air Races, where it averaged 285 m.p.h. over the official three-kilometer course.

Among the host of record attempts which are the usual prelude to the Paris Aeronautical Exhibition, and which were reported on page 452 of the November issue of AVIATION, should have been included an altitude record with a load of 1,000 kilograms (2,200 lb.) by M. Signerin. Flying the Breguet XIX biplane, powered with a 700-hp. Gnome-Rhone K.14 engine, in which he made a new record in the 500-kilogram load category, M. Signerin reached a height of 30,996 ft.

Another altitude record, for light planes of the second category (two-place planes of less than 616 lb. empty weight), was chalked up by the Polish pilot, Zrzewiecki, flying a R.W.D-7 monoplane. He reached a height of about 19,700 ft. The previous record, which the Polish pilot exceeded by about 2,500 ft. had been set in April, 1931, by Pilots Reginensi and de Zifcaya flying a Farman 230, powered with a Salmson 40-hp. engine.

Intercity records for which are awarded the Bibesco cups also were established recently by French planes. In a Breguet 33 sesquiplane, powered with a 650-hp. Hispano-Suiza engine, Colonel Boustat and Commandant Tavera of the French Air Ministry, flew from Paris to Bucarest at an average speed of 148 miles an hour. The Italian Bibesco cup, awarded for the best speed between Rome and Bucarest, was won by Captain Potez and Adjutant Manolescu of the Rumanian Air Corps. Their Potez 50, with 700-hp. Gnome-Rhone 14 K. engine, duplicate of the one with which two speed records with useful loads were made in September by M. Lemoine, averaged 172 m.p.h. between the Italian and Rumanian capitals.

Not only winner but also sole plane to finish the 1,040-mile race around France for the Zenith cup was a Puss Moth monoplane flown by the French test pilot, M. Becroyet. Accompanied by two passengers, he flew the circular course from Orly, near Paris, in 9 hours 10 minutes, including stops at Lyons, Bordeaux, Marseilles and Tours. This year's Zenith victory, fourth in succession to go to a British airplane, was made by the only British entrant in the event. Begun in 1929 by H. S. Broad, chief test pilot for the de Havilland Co., the triumphal series was continued in 1930 and '31 by Edouard Bret, French air enthusiast and Puss Moth owner.

Three of the five contestants in the Argentine Trophy Race starting and finishing at Buenos Aires were British planes. A Farman 234 monoplane with 95 hp. Salmson engine, the only French entrant, carried off the Myriam Stafford Trophy and the prize of almost $4,000. Flown in five laps across fourteen provinces and the territory of Chaco, the 2,500-mile course went well into the foothills of the Andean Cordillera. The winner's time was slightly under three days, runner-up nearly a day longer, while the other entrants did not finish the race.

Local air meetings

Air shows and demonstrations have held the aeronautical stage in this country. During a two-day air pageant at the Rhode Island State Airport, James Wedell made a new attempt on the world's landplane speed record. Though he was clocked at 301 m.p.h. on one lap of the three-kilometer course, his average speed fell short of the 292-mile record established by Maj. James H. Doolittle at Cleveland a few months ago. Some two hundred airplanes participated in the events and exhibitions which are to be an annual affair at the Rhode Island field.

Thirty planes, largely privately owned, were on the program staged at Boston Metropolitan Airport at Norwood a few days earlier. More than 7,500 persons attended the second annual air show of the Flushing Airport, Flushing, L. I. on Oct. 30 to witness a program of stunting military maneuvers, bomb-dropping and speed contests. Clyde Pangborn, Clarence Chamberlin,

Marjorie Doeg and about ten other popular pilots formed the cast.

To provide for the discussion and change of ideas on technical and research problems in aeronautics, to provide a clearing house for findings in aerodynamics, meteorology and kindred fields of research, an Institute of Aeronautical Sciences has been created. Comdr. Jerome C. Hunsaker, vice-president of the Goodyear-Zeppelin Corporation and one of the originators of the idea which has been simmering for some time, was elected president. A trio of vice-presidents of the Institute is made up of Charles L. Lawrance, President of the Aeronautical Chamber of Commerce, Grover C. Loening, airplane designer and manufacturer, and Edward P. Warner, editor of AVIATION. Lester D. Gardner, a former manager of the Chamber, is secretary.

Airlines plan for the winter

Faster schedules, additions to schedule, and on some lines even extensions of routes, have replaced the retrenchments which used to be the order of the days just preceding the winter season. Transcontinental schedules on both the United and Transcontinental & Western Air are faster and more frequent. Eliminating the overnight stop at Kansas City, rearranged schedules in effect Nov. 5, make it possible to leave New York at 8:10 p.m. and be on the Pacific Coast at 9:50 the following evening. Forty-eight hours was required for the transcontinental trip at the time of its inauguration in 1929. In addition to this new service, Transcontinental & Western Air will continue to operate the 36-hour coast-to-coast schedule which provides for a night in Kansas City. United provides a second daily schedule on its transcontinental route via Chicago, a midnight departure from New York bringing the passenger to Chicago at 8:45 a.m. and to the Pacific Coast early the second morning.

An extension of Transcontinental & Western Air's coast-to-coast route from Indianapolis up to Detroit by way of Toledo and Ft. Wayne gives these cities their first direct connection with the Pacific Coast, in less than 21 hours flying time. Wichita is 10 hours, and Albuquerque, N. M. 15 hours away. A new seven-passenger Fleetster transport, with a cruising speed of 150 m.p.h. is being used for the first time on the Detroit-Indianapolis section. Before winter flying begins all Transcontinental and Western Air planes will be fitted with rubber "boots." Attached to the leading edges of the wing and tail surfaces, these de-icers are alternately inflated and collapsed by an engine-driven pump to shake off sleet and snow collecting there.

Traffic increases; new schedules

Demands for Transamerican Airlines' air passenger and express service between Detroit and Buffalo have caused replacement of the three-passenger planes with which the line opened in mid-October, by larger equipment carrying six passengers and pilot. Transamerican operated a Buffalo-Detroit service some years ago, but discontinued it early in 1931 because of insufficient traffic and lack of connections for eastern points. Now connections can be made at Buffalo with Martz Airlines for the Pennsylvania cities, with American Airways for Rochester, Syracuse and Albany, and with National Air Transport for Toronto.

New flight schedules effective Nov. 1 on Transamerican and United cut half an hour from the Detroit-New York flying time. Leaving Detroit City Airport at 11 a.m. a Transamerican airliner connects in Cleveland at 12:20 with a United plane which reaches New York at 3:54 in the afternoon. Early in the spring, Transamerican expects to put into operation on its Detroit-Cleveland and Detroit-Chicago routes their new fifteen-passenger Condors which are under construction in the Curtiss-Wright plant at Robertson, Mo.

Martz Airlines enjoyed such excellent patronage during the past summer that, contrary to usual practice, operations will be continued through the winter. Only six cancellations on account of weather or other causes were necessary between April 15 and Oct. 1. During this time two schedules were flown daily in each direction over the four-hour run between Newark Airport and Buffalo.

Commencement of its second year of service between Los Angeles and the San Francisco Bay region was celebrated by Varney Speed Lines on Oct. 15. A schedule which requires the Lockheed Orion monoplanes used to cover the 348 miles between San Francisco Bay Airdrome and United Airport in Burbank, just north of Los Angeles, at an average speed of 180 m.p.h., is flown four times a day in each direction. The six-passenger planes average a loading of about 65 per cent of capacity.

New transport activities

Several new airlines started operation during the autumn months. California Aerial Transport, Ltd., flew its first daily plane between Glendale and Calexico from the Grand Central Air Terminal on Sept. 25. Stops will be made at Riverside, Palm Springs and El Centro. Fare between Glendale and Calexico is $12.50.

Another attempt to link Mexico City with the Southwest was begun on Oct. 20 by the Central Mexican Airways Company, a Mexican corporation. Twenty-hour passenger, mail and express service is to be maintained between the Mexican capital and Phoenix, Ariz. Planes leaving there twice weekly at nine in the evening connect at El Paso with the Mexican line, on which 12-passenger Fokker tri-motors are used.

Though no contracts for the carriage of mail have been awarded as yet by the Canadian Post Office Department, Canadian Airways has decided to offer a service from Quebec along the north shore to Seven Islands during the coming winter. Passengers and express can cover the 380 miles in three and a half hours by airplane, while almost a month is required to make the trip by dog sled, the only other means of transportation after the freeze-up.

A plan for the provision of landing and take-off facilities for amphibions and flying boats near the west side of Manhattan seems near realization. The plan calls for a float moored to one of the west side piers, waiting rooms and ticket offices on the pier, and a river patrol to keep the site clear of driftwood. The tentative site was selected after an extensive survey of the Manhattan district. Test flights in a ten-passenger amphibion were made to Floyd Bennett Airport in six minutes. The trip requires more than an hour by automobile. The practicability of the plan thus being assured, it awaits the approval of the Commissioner of Docks.

New in the field is the Chamberlin, Holmes & Company, organized to specialize in all phases of air transportation, including surveys, reports, financing and construction of airports, aircraft and airways. Col. Clarence D. Chamberlin, trans-Atlantic flier and airplane designer, and E. H. Holmes, formerly head of the General Aviation Corporation and founder of Holmes Airport in Jackson Heights where the Goodyear dirigible airship is based, share the conduct of the business. Its chief assets

FIRST FLIGHT

On Nov. 19 this monument to Wilbur and Orville Wright was dedicated at Kitty Hawk, N. C. For its foundations Army engineers anchored the sands of Kill Devil Hill which had moved 400 ft. since the Wrights' flight over it 29 years ago.

are the manufacturing facilities of the Chamberlin Aircraft Company in Jersey City and the operating facilities of Holmes Airport.

Air express rate reductions

By way of celebrating the fifth anniversary of the inauguration of its air express service the Railway Express Agency has announced a general reduction in air express rates. Fourth in effect since 1927, the new tariff has a base of 2 cents per lb. per 50 miles for packages weighing over 21 lb. and an appropriately low arbitrary for lesser weights. A 10-lb. package now travels between New York and Chicago for $3.44, 96 cents less than the rate in effect since last December and barely one-third the 1930 charge. The New York-Los Angeles air express tariff for the same weight is $10.44. Addition of the Kohler Aviation Corporation and Rapid Air Transport to its air express system brings the Railway Express Agency's air-mileage up to 11,266 miles. United Air Lines, Northwest Airways, National Parks Airways and Western Air Express are the main strings of the network.

Provision for regular air commuters is begining to be made by airlines. Ludington Lines on Nov. 1 placed on sale "airbooks" containing eight tickets for the price of seven, each good for a one-way passage between New York and Baltimore or Washington. In addition to saving the regular traveler 14 per cent on his ticket price, the airbook simplifies reservation making, as only its number is necessary to secure a definite reservation by phone. Books of tickets are sold by French Air Union lines at from 20 to 30 per cent below the usual figure. Ten thousand francs worth of tickets are sold for 7,000 francs and 5,000 francs worth for 4,000 francs. These reductions are in addition to the usual discount granted on round-trip tickets, and the books may be used by several persons if their names are listed when the purchase of the book is made.

A new Aeropostale scandal

French aeronautical circles are seething with the storm stirred up by M. André Bouilloux-Lafont, director of the Compagnie Aeropostale, when he brought suit against M. Emmanuel Chaumié, director of Civil Aviation at the French Air Ministry and M. Paul-Louis Weiller, a director of the Gnome-Rhone company. Accusing them of conspiring to secure the control of Aeropostale, now in liquidation, by C.I.D.N.A.; of selling a controlling interest in the Gnome-Rhone concern to Deutsche Lufthansa; and finally, of arranging between it and C.I.D.N.A. for the exploitation of the South American line, Mr. Lafont released a boomerang upon himself. The documents provided by him as evidence have been proven forgeries and strong suspicion of forgeries and errors in the balance-sheets of his own company been revealed by a committee of investigation appointed more than a year ago, but silent until now. So far, however, the guilt has not been fixed.

VIKINGS IN THE AIR

A formation of Danish Fokkers flying over the suburbs of Copenhagen.

New colonial connections

Several new links were forged in Imperial Airways' colonial networks during the recent weeks. New local air services at two points along the Cairo-Capetown route bring African "feeder" services to well over 1,000 miles. Connecting with the main trans-African line at Kisumu, one carries mail, passengers, and freight some 200 miles across the shores of Lake Victoria via Jinja, Torroro, and Eldoret to Entebbe. Another, operated by the Aero Club of Katanga, carries passengers from Broken Hill, an Imperial station, to Elizabethville, in the Belgian Congo, and, if they wish, on to Luluabourg in Central Congo. Moth planes are used on both routes.

Since the termination of the Imperial Airways' agreement with the Persian government and its refusal to renew permission for the use of Persian aerodromes, a new route has been followed to India. The Hannibal type airliners, their fuel capacity increased to give a range of 620 miles, now fly along the southern shore of the Persian Gulf from Basra instead of following the slightly shorter northern coast line over Persia. At Gwadar in British Baluchistan, after a 340-mile non-stop flight from Sharjah across the Gulf, the old route to Karachi can be followed without political complications.

British colonial mails will be greatly accelerated when the new mail carriers, the first of which is nearing completion at the Boulton and Paul factory in Norwich, are in operation. The Air Ministry specifications according to which the plane was designed are far exceeded by the estimated performance figures which give it a maximum speed of 195 m.p.h. and a cruising speed of 172 m.p.h. at ¾ maximum power. Two Bristol Pegasus engines rated at 555 b.hp. power the ship which weighs 10,500 lb. fully loaded, carrying at least 1,000 lb. of mail, a crew of two and fuel for 1,000 miles at average speed. Outstanding points in its construction are high-tensile steel spars and light alloy ribs.

Fast planes for American markets

New, fast transport planes are projected by several American manufacturers. Engineers of the Lockheed Aircraft Corporation at Burbank, Cal., are working on a low-wing cantilever monoplane, a direct descendant of the Orion transports which make Swissair one of the fastest European lines. Designed by Lloyd Stearman and his staff, Hall L. Hibbard, Richard von Hake, and George H. Prudden, the new Lockheed will be a ten-place, all metal ship with complete provision for radio, night and blind flying equipment. Performance estimates include a 180-mile cruising speed, 220-mile top speed and a range of about 1,000 miles.

Douglas Aircraft Corporation, which has heretofore concentrated on amphibion and military planes, plans to have its first land commercial transport in the air in about six months. A monoplane with twin engines, the new Douglas is designed to do at least 175 m.p.h. (Douglas amphibions are the fastest of their type.) Its affiliated company, Northrop Aircraft Corporation, will specialize in single-engined monoplanes for mail and freight. Two Northrops now under construction for special private flights will form the basis of future commercial production.

Latest contribution of Kinner Airplane & Motor Corporation to transport equipment is a new radial engine, the largest it has ever produced. At present undergoing factory tests, the new power

plant is expected to develop 270 hp. The company's recently inaugurated airplane production, of low-wing monoplanes, is designed for the private market. Its two-place open model costs $2,500, while its sister ship with closed cabin is more expensive.

Last word in autogiro manufacture is Pitcairn Aircraft's new cabin machine in which James G. Ray, chief test pilot for the company, has just completed test flights. The largest commercial autogiro that has been built to date, it seats four or five passengers, contingent upon the amount of baggage carrried in a large compartment behind the rear seat. Power is provided either by the Wright 420-hp. R-975 E-2 or by the Pratt and Whitney T-3-A of the same horsepower. Two tanks under the fuselage give a total gasoline capacity of 90 gal. Interior arrangements of the PA-19 follow motor-car practice, even to ash trays, side pockets and adjustable windows. (AVIATION, November 1932, page 457).

Airline supplies and equipment

A rush order for three of its seven passenger transport planes has occupied the Fairchild factory at Hagerstown, Md., during recent weeks. Equipped with two-way radio and with space for emergency supplies and provisions, the Fairchilds will start operations almost immediately on the scheduled routes of Pacific Alaska Airways, Pan American Airways' subsidiary.

United Air Lines planes will be fueled for a year with the gasoline recently ordered by the company from the Standard Oil Companies of California and Indiana. Delivery of the 7,000,000 gal. of Stanavo Aviation gas, probably the largest order ever placed by an airline, is to be distributed among the 46 cities at which the line maintains bases. Almost two-thirds of the supply will be used on the New York-Chicago-Pacific Coast route on which 2,500 gal. are consumed on each transcontinental flight. Lubricating oil for a year's operations is provided by a 275,000-gal order placed with the Pennzoil company. A contract covering the gasoline requirements of Transcontinental & Western Air for the coming year has been awarded to the Texaco company which at the present time is supplying its lubricating oil.

Air lines have been active in the electrical equipment market also. United, American Airways, T. & W. A., Western Air Express and National Parks have already placed orders with the Western Electric Company for nearly $100,000 worth of aviation radio-telephone apparatus of a new type announced only eight weeks ago.

Steps have been taken to prevent the recurrence of an incident which might have had serious consequences to the passengers on one of the Chicago-Kansas City planes of United Airlines. A cracked exhaust manifold let monoxide gas into the fresh air stream and so into the cabin where three of the passengers were overcome. As a precautionary measure the exhaust manifolds of planes now in service will be made of a different metal and will be inspected and replaced more frequently. The new Boeing transports to be put into service shortly will have steam instead of hot air heat, making it impossible for contaminated air to reach the cabin.

Italians to visit Chicago

Twenty seaplanes of the Italian air force, led by Air Minister General Italo Balbo at the controls of his own plane, will start from Orbetello late next March on the long-rumored formation flight. Original plans were for 36 planes to circle the world, but observers sent to the Aleutian Islands and other distant parts reported the difficulties encountered in providing for such a fleet to be insurmountable at the present time. So Chicago will be the objective of the Savoia S-55's. Similar to the ten planes used on the group flight to South America in December, 1930, each has two 500-hp. Isotta Fraschini engines, carries a crew of two pilots, a wireless operator and a mechanic. Outward bound, the formation will follow the northern route by way of England, Iceland, Greenland, Newfoundland and New York. The return is scheduled to be non-stop across the Atlantic, from Newfoundland to Ireland, or Bermuda to the Azore Islands.

Reports from the Chaco front have finally included an airplane fight. Two Paraguayan planes supposedly trying to bombard the Bolivian Fort Aroe were met by defending planes. Shots were exchanged and, though apparently none of them reached their mark, the bombing mission dispersed. More recently a squadron of ten Bolivian planes is reported to have flown over Fort Nanawa, dropping bombs on large concentrations of troops and ox-carts with troop supplies, and effecting many casualties. Nanawa, one of the Paraguayan strongholds in the Pilcomayo sector, is the headquarters of the Paraguan army and preparation center for attacks against the Bolivian forts Agua Rica, Murguia, and Saavedra.

Experiences in Manchuria and Shanghai have stimulated Japanese interest in the state of the national air forces. Budgets which the Navy Department is now discussing with the Japanese treasury include about $21,000,000 for five new naval air bases and provision for one 13,000-ton aircraft carrier allowed in the London agreemnt. On the other hand the Japanese naval delegate to Geneva is urging the restriction of aircraft carriers and cruisers capable of carrying aircraft, on which any outside attack on the island would depend.

Corporation activities

For twenty-eight trading sessions from Sept. 19 to Oct. 21, United Aircraft & Transport held the spotlight of New York Stock Exchange activities. A spectacular turnover in that time of 3,409,600 shares made it the most traded stock on the board.

In line with the reputed improvement in general business conditions, the report of American Airways for the third quarter shows the smallest operating losses so far this year. Airline operating subsidiary of the Aviation Corporation, its last quarterly deficit was $30,367, as compared with $563,808 for the second quarter, and $444,933 for the first three months of this year. A 14 per cent reduction in airline operating expenses and increased revenues from passengers and express share the responsibility for this improvement.

Bendix Aviation Corporation, only part of whose activities are in the aeronautical field, tells a different story. For the quarter ended Sept. 30, its net loss after taxes, depreciation, interest and other charges was $315,180, against a loss of $78,490 in the preceding quarter, and a net profit of $275,631, or 13 cents a share on 2,097,663 shares outstanding, for the third quarter of 1931. Net loss during the first nine months of 1932, after the above charges, was $367,307, as contrasted with a net profit, including $411,000 non-return income of $1,787,976 for the same period last year. This was equal to 85 cents on each of the no-par capital shares outstanding.

A report of Imperial Airways of Great Britain for the fiscal year ending March 31, 1932, is also on the darker side. Its profits were $42,738, little more than half the figure for the previous fiscal year. Nevertheless, increased traffic led the directors to recommend a 3 per cent dividend, the same as for the previous year. Total traffic ton-mileage for the last six months of the fiscal year just passed almost equalled the total for the previous twelve.

Personnel

Charles Sherman ("Casey") Jones on Dec. 1 resigned from the Curtiss-Wright Corporation. Since war-time when he flew with the 96th French Pursuit Squadron, and directed training at Issoudun, Jones has been connected with the Curtiss organization—as test pilot for Curtiss Airplane & Motor Company, as head of Curtiss Exhibition Company, as vice-president in charge of the public relations of Curtiss-Wright Corporation, and finally as manager of the Curtiss-Wright Air Terminals at Valley Stream and North Beach, L. I. Pleading need for a vacation, Casey Jones has had nothing to say about his plans.

Robert Lehman has been elected chairman of the board of directors of Aviation Corporation, to take the place of W. A. Harriman, who recently resigned to become chairman of the board of Union Pacific Railroad Company. Mr. Harriman remains a member of the board and of the Executive Committee of the company. Sherman M. Fairchild succeeds him as chairman of the executive committee.

At a recent meeting of the stockholders of the General Aviation Corporation, Ernest R. Breech, Fred J. Fisher, A. H. G. Fokker, Harris M. Hanshue, Hugh M. Hogan, James M. Schoonmaker, Jr., John Thomas Smith, Edward R. Stettinius and C. E. Wilson were elected directors.

In a new set-up of the traffic divisions of American Airways, which reduces the number of territories from ten to five, A. C. Stevens, George Swayne, Arthur L. May, Max Pollet and William N. Bump, become city traffic managers in New York, Hartford, Boston, Albany and Providence, respectively. Goodrich K. Murphy, as division manager, remains in charge of the eastern division.

F. V. Tompkins has been appointed flight operations manager, and C. M. Belinn, general maintenance superintendent of Ludington Airlines, Inc., to head up the two new departments created to replace the general operations department recently discontinued. Tompkins has been chief pilot of the line since Aug., 1930, while Belinn has been with the company since its beginning in the capacities of chief of plane service and superintendent of maintenance.

Coincident with the extension of Transcontinental & Western Air's Pacific Coast service through to Detroit by way of Indianapolis, Toledo and Ft. Wayne, J. B. Taylor, former city ticket agent at Pittsburgh, was appointed district traffic agent at Detroit. W. F. Neidernhofer is to be transportation agent in charge of field activities in that city.

Charles L. Messenger of Buffalo, has been appointed traffic representative for Transamerican Airlines at Buffalo, and for the eastern and Canadian region in general. Dating his air transport experience from 1928, Messenger had been connected with the old Colonial Airways at Syracuse, directed the Buffalo-Toronto service, which was discontinued in October, 1929, and assisted in the establishment of American Airways' passenger service from Buffalo to Rochester and Syracuse.

WILLIAM S. BROCK, who with Edward F. Schlee in 1927 reached India in an attempt to circle the world, died on Nov. 13 in Chicago after an illness of several months.

SIDE SLIPS

By Robert R. Osborn

WE SEE by the papers that a Greek engineer has developed an airplane which is propelled by a set of foot levers operated by the pilot. We suppose it will be some time before this machine can be perfected and brought over here, but we might as well warn you not to be surprised if you see a

man running wildly around your local airport some time in the future. He might own one of these foot-propelled airplanes, and be just "revving" himself up on the ground before taking off.

This year, for the first time, political candidates made considerable usage of the airplane in getting around to their various speaking appointments. While we are in favor of progress in all things, we do not agree with the changes in political campaigns wrought by modern invention. We don't like the radio which doesn't permit us to see the speaker with his massive jaw swung asunder and his arms waving to the heavens. Another invention, the electrical loud speaker, permits the orator to drown out the voices of his hecklers, thereby eliminating all spontaneous wit from the campaign. Improved advertising methods have done away with the personal slap on the back and the campaign cigar. And now the airplane will eliminate the circus-like special train and the 24-sheet advance billboard notices. Politics is getting very dull and uninteresting, if you ask us. We'll bet that not one of the candidates who used the airplane, had a single ox-roast or torch-light street parade.

Not so very many years ago a designer, in laying out a new airplane, had to make sure that it could be easily converted for use as a seaplane or landplane, training, two seater observation or mailplane, and could be powered with any engine from the Bristol "Cherub" to the Liberty. Lately, with the expansion of the business we had thought that more specialized types were being developed, but it seems that they can still be used in widely different types of flying,—witness the following quotation from an editorial from the Pittsburgh *Post-Gazette*: "Major Doolittle used a racing machine in which earlier in the week he had made a number of speed flights. It was the plane in which Russell Boardman flew from New York to Istanbul (Constantinople). A tough little machine, with a wonderful record of performance." (Thanks to D.H.M. of New Castle, Pa., for the clipping.)

A news item tells us that United Air Lines, after sixty days of operation on an experimental schedule, have placed the Midnight Flyer, between New York and Chicago, on the permanent schedule. The item, which appeared in the New York *Herald Tribune*, states "Passengers leaving on the Midnight Flyer now can see a show in New York at night, take breakfast in Chicago, luncheon in Des Moines or Omaha, and dinner in Cheyenne."

We haven't looked into the details of this new service yet, but think we had better remind United Air Lines that they have a very important tradition to uphold in running midnight transportation out of the city of New York,—the departing time must be set so that all passengers, in order to catch the plane, will have to miss half of the last act of the show they are seeing. At one time we lived on Long Island, which makes one automatically a slave of the Long Island Railroad. The schedule-makers of that road were certainly an ingenious lot, as they made it impossible to see the finale of even the theater nearest to the station, and still catch the last train home. Even when the Police Commissioner required one group of theaters to start fifteen minutes ahead of the rest, to relieve traffic congestion, the railroads immediately changed their schedules just enough to catch the commuter

who didn't start down the aisle just as the chorus swung into their specialty.

An so United Air Lines will have to make sure that this matter has been attended to, if they are going to have any respect for the past traditions of transportation,—but possibly we are unnecessarily alarmed; maybe the "experimental schedule" was to check this important detail.

FLYING EQUIPMENT

The four-passenger Beech biplane

A departure from the conventional

BY FAR the majority of the aircraft discussed in these columns during the last twelve months have had at least one characteristic in common,—they have lacked aerodynamic novelty. Improvements have been very much in evidence, but they were essentially refinements in accepted design standards, and radical variations have been sedulously avoided. A new ship has been successfully test flown, however, which, although containing many conventional features, shows definite originality. Walter Beech, well known pilot and designer, onetime president of Curtiss-Wright, has produced in Wichita, Kan., the first of a new series of Beechcraft embodying unusual characteristics.

Negative stagger has occasionally appeared on certain military machines to improve the visibility ahead and above from a forward cockpit, but the 38 per cent negative setting of the top wing of the Beechcraft is a marked departure in American commercial practice. The reason for its adoption is essentially the same,—better pilot visibility forward, coupled with certain structural advantages, chiefly the location of the front spar of the top wing with relation to the fuselage and landing gear. The single set of flying wires is attached to the upper front spar at the outer strut fittings, and pass through the lower wing to the landing gear, thus forming a very deep and rigid trussing system.

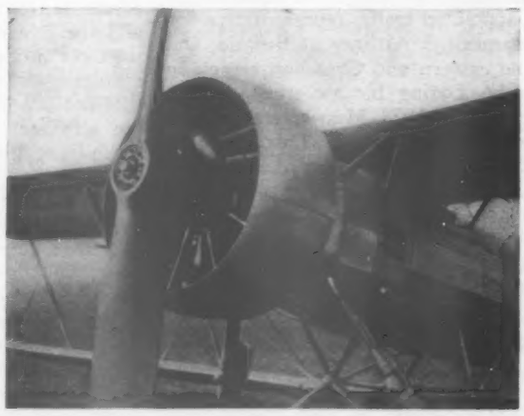
Aerodynamically, negative stagger has been viewed with some suspicion in the past on account of a tendency of the lower wing to "blanket" the top wing at high angles of attack, sometimes resulting in uncomfortable stalling and spinning tendencies. Wind tunnel tests on the new model, with its unusually high degree of negative stagger, have indicated, however, that the lift curve of the Beech cellule is relatively flat topped, and has no marked tendency to fall off sharply at angles of attack as high as 30 deg. It is claimed that the combination of airfoil and the arrangement selected results in an improvement in air flow over the top wing at angles near the stall.

The apparent "cleanness" of the design indicates not only high top speed for a given power expenditure, but also points to high landing speeds and consequent difficulties in getting down into limited areas. Numerous expedients such as flaps, spoilers, "air brakes," and the like have been tried to kill the tendency of such ships to pick up speed in a glide. The last named device is employed in the British designed Puss-Moth, and in the Beechcraft. On the former, the parasite drag is built up in a glide by turning two wide landing gear struts broadside to the wind (AVIATION, September, 1931, page 555). The same effect is obtained on the Beechcraft by the use of a split rudder. For steering, the two surfaces of the rudder are locked together, and function in the normal manner. To kill excessive gliding speed, however, the two halves may be swung apart, and thus act as retarding vanes. During the early stages of the landing roll, the aerodynamic effect of the "decelerators" is of assistance to the mechanical brakes in bringing the machine to a stop.

The landing gear is completely enclosed in housings which are faired smoothly into the lower wing and into the fuselage through a pair of short stubs. The tail wheel is non-swivelling, and is almost completely enclosed, in the under part of the fuselage. This construction makes for simplification in design and saves weight and maintenance expense. It has little apparent effect on the ground maneuverability of the machine. Advantage has been taken of the space afforded by the fillets at the intersection of wing, stub and gear to install large landing lights. The wheels are semi-retractable into the housings. Even in the full up position, however, enough of the wheel protrudes to permit a safe landing. The operation is through electric motors. Similar servo-motors are used to adjust the stabilizer setting.

The fuselage is completely metal covered, and is insulated to a point behind the cabin. All fairings at the wing roots, undercarriage and fin are integral parts of the covering. The enclosure of the cockpit forward is worthy of note, as it carries out the fuselage lines to an unusual degree.

Ailerons are mounted on lower wings only. They are of high aspect ratio, and are rigged for differential operation,—45 deg. up and 15 deg. down,—a feature which improves control at the stall. Wing beams are of steel, with



The business end of the Vickers Vespa airplane on which Captain Cyril Uwins set a new altitude record of 43,976 ft.

ribs spaced 6 in. apart. All surfaces are fabric covered. A single streamlined, heat-treated strut of the racing type connects upper and lower panels in each bay. The wire and cable fittings are enclosed in the wings.

All flying controls are fitted on ball bearings which are sealed against dust and which require no lubrication or attention. Considerable study has been made of the accessibility of all parts for maintenance. Engine cowling, for example, is put on in hinged sections which may be readily lifted or removed. The nose section is fixed to the engine, and only the rear panels need be lifted for servicing.

The engine fitted in the present Model 17R is a Wright Whirlwind R-975E-2 swinging a Smith controllable pitch propeller. The ship has also been analyzed for the new Wright twin-row 650-hp. radial. Engine driven fuel pumps are mounted, although a hand pump is available for emengency operation. Many accessories are included as standard equipment. Radio sets are installed, and five separately operated parachute flares are mounted under the fuselage. Cabin lighting and ventilation are provided for, and ample luggage space is available.

The general characteristics as furnished by the manufacturer are: Span, 34 ft. 4 in.; length, 24 ft. 2 in.; height, 8 ft. 7 in.; wing area (including half area across fuselage), 300 sq.ft.; weight empty, 2,700 lb.; useful load, 1,800 lb.; gross weight, 4,500 lb.; wing loading, 15 lb. per sq.ft.; power loading, 10.7 lb. per hp.

Pegasus makes the highest jump

IN HIS record flight of Sept. 16, to clear the world's altitude record by 800 ft., Flight Lieut. C. F. Uwins used a standard Vickers Vespa biplane fitted with a Bristol Pegasus engine, which had been modified somewhat from the standard for work at extreme altitudes. This engine is a development of the Jupiter, a well-known British service type. It is a nine-cylinder radial air-cooled engine of conventional design. The standard Pegasus models S-2 and S-3 are designated as high altitude service types with a normal compression ratio of 5.3:1, and a normal sea-level output of 550 hp. The model S-3 has a 2:1 gear reduction. On the specially built S-3 for the high altitude attempt resulting in a new world's record, the compression ratio was boosted to 7:1, and a centrifugal type supercharger installed. The rotor of the supercharger is similar in form to the well-known General Electric type, and is housed in the conventional manner at the rear of the engine. It is gear-driven from the crankshaft at a top speed of 2,300 r.p.m., at which speed the total compression ratio in the blower is 1.8:1. Although normally the throttle should never be fully opened at ground-level, tests have indicated that with full supercharging the engine actually develops 1,100 hp. at sea-level. Calculations indicate that at the altitude reached by Lieutenant Uwins, the actual output was about 170 brake horsepower. Plans are now under way to increase the compression ratio to 8:1 in the hopes of raising the ceiling another 2,000 ft. with the same airplane and the same engine.

For the tourist—the Heinkel He64

Heinkel He64 from the 1932 Rundflug

SLOTS, flaps and extraordinarily careful attention to design details, have made possible an almost unprecedented speed range for the Heinkel He64 monoplane, which scored among the leaders of this year's International Touring Competition. Its remarkable ratio of high speed to stall of four to one has been exceeded only in certain of the Schneider Cup Races. One of the five Heinkel machines entered in the Rundflug completed the 4,700-mile course at an average speed of 145 m.p.h., and the other four finished without delay or accident. The Ernst Heinkel Aircraft Corporation, with factories at Warnemünde, Germany, has, in building a machine for general sports purposes, departed somewhat from a previous policy of producing special-purpose machines only, such as those installed on the "Bremen" and "Europa," for catapulted ship-to-shore mail service.

The word "sleek" has been seriously overworked, but since it has not appeared in these columns for some time we will risk its use here to describe the He64. The selection of an inverted in-line engine (Argus, Gypsy III, or Hirth) has permitted the use of a narrow oval-shaped fuselage which is unusually long as compared with American light plane practice. The two tandem cockpits are completely covered with a semi-circular transparent housing with panels sliding fore and aft to permit easy access. The line of the cockpit enclosure is carried along the top of the fuselage into the fin. The structure itself is semi-monocoque, consisting of wooden bulkheads and longerons, covered with three-ply wood. Doors are provided in the covering at strategic points to permit inspection of the interior. The rubber-insulated steel tube engine mount is fastened to the first bulkhead, which is fireproof. The main oil tank is located immediately behind the fire wall, and a secondary tank is fitted in the coaming between the front and rear cockpits. Both seats are adjustable and dual controls are fitted.

The wing is trapezoidal in shape, is built entirely of wood, and is attached to the fuselage through short stubs. Following European practice in general, and the requirements of the recent touring competition in particular, the wings may be folded back against the fuselage for storing purposes. A simple lever-operated latch permits the retraction of the wings complete in about 50 seconds. The panels are full-cantilever, built around a single spar, and are provided with interconnected automatic slots and trailing flaps. This is said to be the first application of slots and flaps on a machine with a single-spar wing. The tail surfaces are of similar construction to the main wing,—plywood covering on wooden ribs and spars.

The split axle undercarriage is of conventional design, braced by vee struts from the underpart of the fuselage. Oleo-air absorbers take care of the landing shocks, and the wheels are fitted with brakes operated by a hand lever.

With an eye toward the limited maintenance facilities of the average sportsman owner, the Heinkel He64 has been carefully studied for accessibility and interchangeability of parts. All components are easily available for inspection, and no special tools are required for repair work. Spare parts are furnished ready for installation without adjustment. The equipment includes such accessories as fire extinguishers, parachutes, life preservers, first-aid kits, safety belts, instruments, etc.

The specifications furnished by the manufacturer are: span 32.2 ft.; length 27.3 ft.; height 6.75 ft.; wing area 155 sq.ft.; weight empty 990 lb.; useful load 660 lb.; gross weight 1,650 lb.

THE INTERNAL COMBUSTION ENGINE, *by D. R. Pye; Oxford at the Clarendon Press, 1932; Cloth 6½x9½, 250 pages, illustrated.* Frankly confining itself to basic principles in the field of combustion and thermodynamics as applied to the internal combustion engine, and to the results of the latest research in this field, this book covers the ground with extreme thoroughness, and with the competence born of Mr. Pye's extended and eminent work in this field. It is, happily, not cluttered with extraneous descriptive material. It presupposes familiarity with all of the elementary aspects of the internal combustion engine, and is written especially for the trained engineer, or for the advanced student of the subject. For them, it is quite the best work which has thus far come to the reviewer's attention—C. F. TAYLOR, *Mass. Inst. Tech.*

THE BEAUTY OF FLIGHT, *by Manfred Curry; John Day Company, New York; 1932; 100 pages; $5.* Undoubtedly the most beautiful collection of aerial photographs, and especially photographs of cloud formations that has ever been published. A perfect art gallery bound between covers. The pictures come from many countries, including some fifteen from the U. S. Navy and a like number from Fairchild Surveys, and have been selected and arranged by Dr. Manfred Curry, famous authority on the aerodynamics of sailing.

SIMPLE AERODYNAMICS AND THE AIRPLANE, *by Col. C. C. Carter; Ronald Press; New York, 1932; 594 pages, $4.50.* The latest developments of Monteith's well-known manual, first prepared at McCook Field seven years ago. This latest edition is a good general manual on design practice, though it is still much more advanced in treatment of some sections than others. An ideal text for a general course in aeronautics would contain more material on design practices and structures and less on aerodynamic refinements. A good list of questions, for examination or review, is appended to each chapter.

WINGS OVER POLAND, *by Kenneth M. Murray; D. Appleton & Company; New York; 1932; 363 pages; $3.* The story of the Kosciuszko squadron, 1919-21. The events described were interesting and exciting, and little has hitherto been known concerning them, but the style of the book is irritatingly melodramatic.

NIGHT FLIGHT, *by Antoine de St.-Exupéry; Century Company, New York; 1932; 198 pages; $1.75.* A short novel, in which romance is of almost insignificant importance as compared with the struggle with the elements. "Night Flight" has been acclaimed as a masterpiece by the literary critics of Paris and America. Aeronautical readers will acclaim it from a point of view all their own, for this tale of a hard-boiled operations manager and his men and how he managed them, and of the episodes of one flight through a South American storm, stands in a class by itself as an interpretation of human psychology through the particular and novel medium of air transport. The author is a former pilot on the Aeropostale Lines in South America, and is as well acquainted with airplanes, engines, and radio, as with pilots and transport executives and their emotions.

WHAT OUR READERS SAY

TO THE EDITOR:

I have read with much interest the abstract of an article by Lieut. Logan C. Ramsey. In general, I agree with Lieutenant Ramsey's conclusions, but I dissent from his viewpoint that a bomb is potentially more destructive than a torpedo.

There are two great difficulties about bombing. The first is the difficulty of hitting your mark. There are six major sources of error.

1. The difficulty of maintaining the longitudinal axis of your plane exactly level.
2. The difficulty of maintaining the transverse axis of your plane exactly level.
3. It is impossible accurately to control the airspeed.
4. Similarly, it is needful to know the speed of the air relative to the sea.
5. There is a serious danger of error in estimating the height.
6. Personal equation will cause an appreciable error.

All six of these elements of error are wiped out in the case of torpedo-carrying seaplanes.

Second, comes the danger to the bomber, which makes 10,000 ft. a minimum distance of reasonable safety at which to fly when the weather is clear and, of course, if the weather is not clear, it impedes the vision, both of the attacker and the attacked. In order to have a reasonably good chance of hitting a warship from a height of 10,000 ft., it is needful, first, that the plane should fly in level flight. Second, that it should fly in straight flight, not altering its compass direction during the attack. Third, that it should fly at uniform speed, thus incomparably facilitating the task of the anti-aircraft guns in scoring hits. After dropping its bomb, to be sure, it can swerve and become a practically impossible mark for any anti-aircraft gun. The torpedo-carrying seaplane, on the other hand, can approach on a curve, changing its direction, its speed, its altitude every second and making the most difficult possible mark for an anti-aircraft gun to hit. It is a very easy matter to lay down a smoke-screen around a battleship or a fleet, with machines flying in zigzag course, at varying speeds and varying altitudes, thus reducing to a negligible point the danger of being hit even at comparatively close approach.

With the torpedoes now available, the distance that they will proceed under their own power is great enough to reach the most distant vessel in a fleet from a point to which an intrepid naval aviator would dare to approach without more danger than it is usual to face in war.

If the fleet is proceeding in column, and the torpedo-carrying seaplane attacks from behind a smoke-sceen, there is about one chance in three of hitting something. Under any conditions, the chance of scoring a hit is far greater than in any other form of marksmanship in warfare that I know of.

Now, there are certain conditions under which the bomber is better than the torpedo-carrying seaplane. In the first place, when a torpedo-carrying seaplane descends to deliver its blow, it subjects itself to the attack of pursuit planes and an adequate force of pursuit planes would keep torpedo-carrying seaplanes at a safe distance and make it much more dangerous for them than for bombers which might be able to deliver an effective attack before the pursuit plane could get above them or near enough to them to be dangerous.

GODFREY L. CABOT
Governor-at-Large
National Aeronautic Association

TRANSPORT

Operations and Traffic Management

Promoting South American air travel with figures

THE Scadta Airways System of Columbia, S.A., through its New York representative, have recently sent out to certain firms doing business in South America a very excellent 4-page promotional letter, analyzing the problem of travel in that continent, and indicating the actual savings in time and money which can be realized by the use of their planes. The letter points out that a traveling sales force can be an active factor in any firm's financial policy only in so far as it fulfills its mission in a minimum of time. It is estimated conservatively that each salesman must earn at least twice the amount of his salary to warrant his trip. Based on the two to one assumption, it is pointed out that employees who earn as little as $200 a month must travel by air in order to make many South American trips remunerative. This contention is supported by several numerical examples, of which one is reproduced below, showing a comparison of the cost of travel by water and by air between New York and Bogota.

Water Route	Days	Expense
New York - Buenaventura, steamship ticket	8	$165.00
Incidental outlays on board	..	35.00
Tips on board (10 per cent)	..	13.00
Hotel in Buenaventura	1	5.00
Railroad fare and automobile between Buenaventura and Cali	1	6.00
Hotel in Cali	..	5.00
Railroad fare, meals, hotel and automobile between Cali and Ibague	1	15.00
Railroad fare and meal between Ibague and Bogota	1	10.00
Salary for twelve days at $200 per month, or $6.65 per day	..	79.80
Loss in income (2 to 1)	..	159.60
Total	15	$493.40

Sky Route	Days	Expense
New York - Miami, railroad fare including pullman	1½	$65.10
Hotel in Miami	..	5.00
Air passage Miami - Barranquilla	1½	135.00
Hotel in Kingston and Barranquilla	..	10.00
Air passage Barranquilla - Bogota (Scadta)	½	130.00
Salary for 3½ days at $6.65	..	23.30
Loss in income (2 to 1)	..	46.60
Total	3½	$415.00

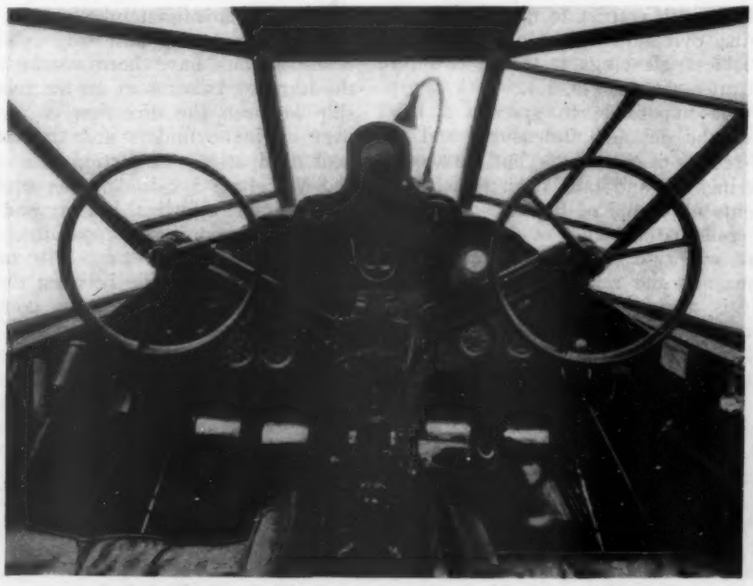
Beyond the actual cost savings pointed out in these tables, attention is called to the advantages of air travel as a means of reducing traveling fatigue. It is argued that salesmen arrive at their destination with 100 per cent of their normal selling energy available. Air express rates are also quoted for the transport of samples and other heavy material required by salesmen.

New transport instrument board

AS A RESULT of a long and intensive study of methods of instrument flying under the general supervision of Pilot Howard Stark, Eastern Air Transport, Inc., has recently developed a standardized navigation panel unit, which incorporates all the instruments required for flight when outside visibility is limited. The navigation unit has been made totally independent of the other instruments and their mountings. It is supported on brackets in such a way that the instruments line up with the natural eye-level of the pilot, so that a shift to instrument flying does not require any great physical or mental readjustment. In addition to the benefits accruing to the pilots from the re-arrangement, the maintenance problem has been considerably simplified, for all connections on the back of the panel are open for inspection or adjustment. Not only can any instrument be removed from the unit without disturbing the others, but the entire panel may be readily removed by taking out a few screws, and by uncoupling all instrument connections. The new navigational panel has been made standard for all passenger airplanes on the line. A slightly different arrangement is being developed for the Mailwings.

Mechanical check pilot

IT IS becoming increasingly the fashion to attach recording devices to all sorts of production tools and machinery to afford the management a running record of machine output, and, incidentally the operator's efficiency. An application of this character has recently been made on American Airways airplanes flying out of Newark Airport. In this case, a recording tachometer, which is installed for periods of 24 hours at a time, prints on a tape all variations of engine speed during that period. By comparing this record with the schedule of flight, the operations manager can obtain a great deal of important information, such as the speed and length of time of warming up before take-off, the cruising speeds throughout the flights, and idling time on the ground at various stops. It is thus possible to check the handling of the engines by the pilots, and to run down the reasons for excess fuel consumption at certain stations where idling time may be unnecessarily prolonged.



New navigating instrument panel in an E.A.T. Curtiss condor

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TECHNICAL ABSTRACTS

More data on nacelle drag

DRAG TESTS OF 4/9-SCALE MODEL ENGINE NACELLES WITH VARIOUS COWLINGS, *by Ray Windler; Technical Note No. 432, National Advisory Committee for Aeronautics.*

IN THE COURSE of the investigation of interference effect between nacelles and wings now under way at Langley Field, a detailed study was made of nacelle forms apart from the wings, to determine optimum shape and the effect of various types of ring cowling. In these tests no attempt was made to include propeller effect. All results were obtained without propellers.

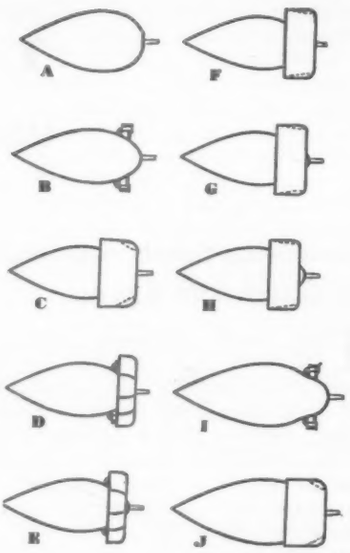
Two general nacelle forms were tested, the first (B) was the so-called conventional nacelle. The second (J) was the N.A.C.A. nacelle. As a general check, a smooth body of approximately the shape and size of the small nacelle was included in the series of tests (A).

The rings applied to the two forms of cowl were of three general types: first, the full N.A.C.A. cowl; second, a series of three fixed-angle rings, and third, a variable-angle ring. The fixed-angle rings were relatively wide and thin, and the angles betwen the ring chord and the thrust line of the nacelle were 0.0 deg., —3.0 deg. and —6.3 deg. respectively. The variable-angle ring was made up in a form of a nine-sided polygon, and the chord angles of each side could be adjusted from zero degrees to —15 deg. with respect to the thrust line. The fixed-angle rings were tested in three different positions fore and aft with respect to the plane of the engine cylinders (F, G, H) and the variable-angle rings tested in two fore and aft positions (D, E).

It is impossible to give in a brief space the detailed dimensions and the full results of these tests, but the accompanying cut and tabulation which represents a résume of the tests scaled up for full-size nacelles at 100 miles an hour, will give some idea of the general forms and the relative values of drag.

It is obvious that the popular belief that almost any kind of a ring cowling will reduce the drag of a radial engine is fallacious. Several combinations of ring and setting gave drags which are considerably higher than that of the bare nacelle. Although the fore-and-aft location of the rings affect the drag, the angle of the ring cord to the thrust line is a much more decisive factor. The full N.A.C.A. hood in its optimum location, gave better results than any combination of fixed or variable incidence ring in any location fore and aft. Even the bare N.A.C.A. nacelle without hood gave lower drag values than most of the variable or fixed-angle ring combinations, and the complete N.A.C.A. nacelle with hood in position yielded a drag figure below that of the smooth streamlined body tested.

Tests were made on all combinations of ring and cowl at various angles of pitch. Here again the full N.A.C.A. nacelle gave the best result. In general those combinations which had the lowest drag at zero degrees of pitch, had the lowest drag throughout the entire pitch range, but the lower the drag of the combination at zero degrees pitch, the higher is the percentage of increase of drag as the angle of pitch is increased. These results cannot be considered as conclusive, for the effect of the propeller must be taken into account. It has been found that the cowling which gives the lowest drag without the propeller is not always the best combination with a propeller mounted. This report must, therefore, be considered as preliminary, as further work will have to be done with complete nacelle and propeller combinations.



Drag of Wright J-5 engine nacelles, full scale at 100 m.p.h. a = angle between chord line of ring and nacelle thrust line.

A. Smooth streamline body. D = 44 lb.

B. Conventional nacelle with bare engine. D = 153 lb.

C. Conventional nacelle with N.A.C.A. hood in optimum position. D = 94 lb.

D. Conventional nacelle with variable angle ring cowl in forward position. a = —8 deg. D = 95 lb.

E. Conventional nacelle with variable angle ring cowl in rear position. a = 0 deg., D = 183 lb.; a = —5 deg., D = 96 lb.; a = —8 deg., D = 100 lb.; a = —10 deg., D = 102 lb.; a = —15 deg.; D = 128 lb.

F. Conventional nacelle with fixed angle cowl in forward position. a = —6.3 deg. D = 115 lb.

G. Conventional nacelle with fixed angle cowl in intermediate position. a = 0 deg., D = 198 lb.; a = —3.0 deg., D = 165 lb.; a = —6.3 deg., D = 121 lb.

H. Conventional nacelle with fixed angle cowl in rear position. a = 0 deg., D = 190 lb.; a = —3.0 deg., D = 158 lb.; a = —6.3 deg., D = 126 lb.

I. N.A.C.A. nacelle without hood. D = 115 lb.

J. N.A.C.A. nacelle wth hood in optimum position. D = 40 lb.

On the problem of engine cooling

HEAT DISSIPATION FROM A FINNED CYLINDER AT DIFFERENT FIN-PLANE/AIR-STREAM ANGLES, *by Oscar W. Schey and Arnold E. Biermann; Technical Notes No. 429, National Advisory Committee for Aeronautics.*

AS the problem of engine temperature control is intimately connected with the development of anti-drag cowlings, investigations have been conducted at the Langley Laboratory on the relationship between the direction of air-flow over engine cylinders and the rate of heat dissipation. A section of a standard Wright J-5 cylinder was equipped with suitable electrical heating and temperature recording apparatus, and mounted in a wind tunnel in such a manner that the angle between the air-stream and the cooling fins could be varied between 0 and 90 deg. Tests were conducted every 15 deg. at several heat inputs, ranging from 13 to 248 B.t.u. per square inch of inner surface per hour, at a constant air speed of 76 m.p.h. Tests were also conducted over the same angular range at a constant heat input of 170 B.t.u. per square inch per hour, at several air speeds ranging from 30 to 150 m.p.h.

Temperature readings on all parts of the cylinder indicated that the rate of heat dissipation is greatest when the cooling air is directed at an angle of 45 degrees with respect to the cylinder fins. For a given heat input the temperature difference between the cylinder and the air-stream is reduced from 30 to 50 per cent with the flow at 45 deg., as compared with air-flow parallel to the fin. The amount of the reduction depends on the air velocity and the point selected in the cylinder. With the same average cylinder temperature, the total heat input to the cylinder can be increased 50 per cent with an air stream angle of 45 deg., as compared with a parallel flow.

AIRCRAFT AT WORK

Air express and the movies

MODERN industries make use of modern transportation facilities as shown in the handling of moving picture news reels by air express. The public appeal of the news reel depends to a great degree upon the speed at which it can be distributed. This is especially true of pictures that carry with them running comments by some one of the well-known loud speakers of the screen, for they cannot be distributed until the appropriate sound recordings have been made and incorporated on the film.

The original films, often worth many thousands of dollars, must be rushed to New York or Chicago or other centers for development, and then back to the chief points for distribution, such as Atlanta, St. Louis or other large cities. A recent incident will illustrate the means employed to insure rapid distribution. A series of pictures of the recent Chinese-Japanese conflict was shipped by steamship from Japan. In order to make satisfactory air express connections for the east, the news reel company chartered a seaplane to pick up the films from the steamer some hours out of Seattle. This was done with considerable difficulty as a heavy sea was running at the time, but, by means of a breeches-buoy life-gun, a line was shot to the steamer's deck, and the package of films hoisted aboard. The seaplane then returned to Seattle where the package was turned over to the Railway Express Agency. Connection was made by Varney Air Lines for Salt Lake City, where the films were then transferred to the regular eastbound schedule of the Boeing division of United Air Lines. Arriving at Newark Airport, the package was rushed by truck to the Pennsylvania Railroad where a special messenger picked it up and transferred it to the film studios in uptown New York.

Frequently news reels arrive at the Newark Airport at night, and in such cases a laboratory force must be kept on hand at the studios at an overtime cost of $350 an hour, to be ready to go to work on the picture. Under these conditions any delay results in real financial loss. The interlocking air express and delivery service, both by day and night, however has practically eliminated difficulties from this source.

Air travel expedites pipe line contracts

BY AN intensive use of the established airlines, two officials of the Babcock & Wilcox Company of Denver were enabled to successfully under-bid their competitors on an $11,000,000 pipe line sub-contract in connection with the Hoover Dam. The necessary negotiations for material and labor which, in the ordinary course of events, might have taken from a year to a year and a half to complete, were successfully closed in five months. During that time the two men traveled over 85,000 miles by air to visit practically every section of the United States.

A flying dress salesman

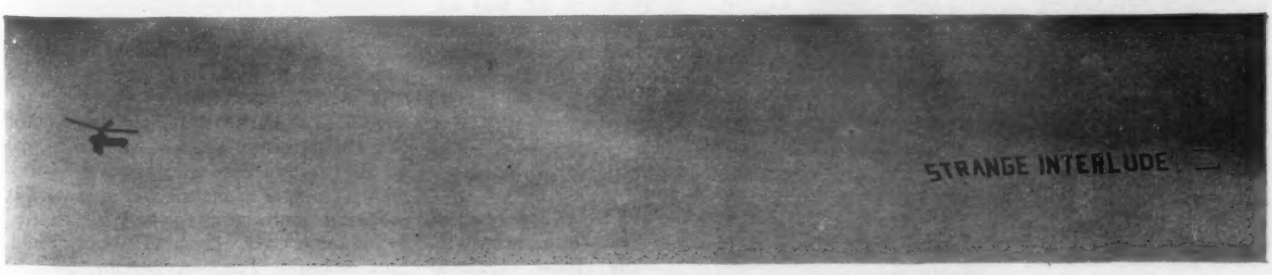
TRAVELERS dropping in on remote villages in Alaska need not be astonished to find the native women dressed in the latest Paris styles. Since conditions of travel make it impossible for the Indian and Eskimo belles to visit the clothing establishments of the large cities, Herb Coleman, proprietor of a dress shop at the town of Ketchikan, conceived the idea of a flying clothing store. For some years he has covered a limited territory by boat, but he has found that his range of operations and his profits have been very materially increased by the use of an airplane. Mr. Coleman purchased a Stinson Junior monoplane on Edo floats, and engaged a pilot to fly the ship. The cabin was fitted up to carry a cargo of dresses, coats and other feminine wearing apparel. In a single season this ship became known all over Alaska as the "Flying Dress Shop." By carefully matching his visits with the pay-off periods at the salmon canneries, Mr. Coleman is able to catch his customers in a spending mood. Only through the use of an airplane would he be able to effect this profitable synchronization. [Courtesy of *The American Weekly, Oct. 2, 1932.*]

Airplanes aid Czech food industries

PROFITABLE interchange of certain perishable foods between Czechoslovakia and the metropolitan districts of Berlin, Paris, Amsterdam and London have been materially aided during the past summer by shipments over Czechoslovakian airlines. The airplanes carry mushrooms, an important product of the country to Berlin and London at an established rate of 12 and 39 cents per kilogram respectively. On the return trips to Prague, the ships carry lobsters, oysters and other sea foods which are at a premium in the land-locked territories of Czechoslovakia. In the past, the range of exports of fresh mushrooms has been curtailed by their perishable nature.

Autogiro sky ads

SEVERAL effective advertising campaigns have been conducted recently over a number of Eastern cities by the use of large signs towed behind Kellett autogiros. The giro itself is still of sufficient novelty to attract attention, and the banner from 150 to 200 ft. long, carrying letters 9 ft. high, trailing about 400 ft. behind the giro makes very effective the advertiser's copy.



A new type of sky writing.

THE BUYERS' LOG BOOK

Welder's truck

AN improved truck for the handling of oxygen and acetylene bottles in welding shops has recently been introduced by the Linde Air Products Company, for distribution by Prest-O-Weld and Purox dealers. The new No. 5 truck increases the ease and convenience of moving a welding or cutting outfit from place to place, and insures a firm support for the oxygen and acetylene cylinders, eliminating possibility of overturning them and breaking the regulators or gages. The frame is of angle iron with a steel plate floor and steel tube handles. The handles, being bolted in place, may be easily removed for shipping or storage. Adjustable chains hold the cylinders in place on the platform. 12-in. wheels with 2-in. tread permit easy handling. The truck is 48 in. high and 30 in. wide, and weighs 80 lb. It is finished in black enamel.—AVIATION, *December, 1932.*

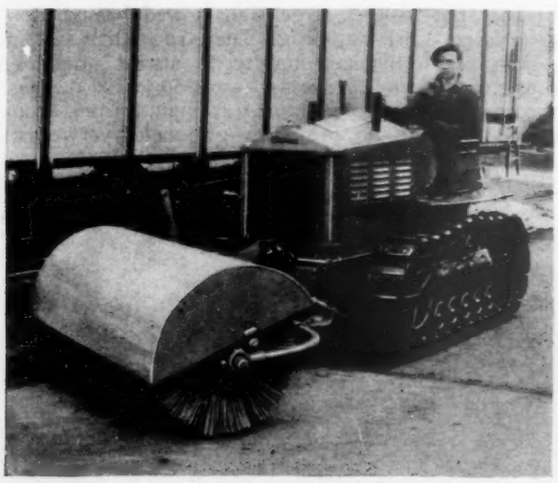
No. 5 Welding cylinder truck

Re-threading dies

BRUISED and battered threads on bolts or studs may be quickly restored to their original condition by means of a new series of "slip-on" re-threading dies recently announced by the Greenfield Tap & Die Corporation. These dies resemble an ordinary round die split in two halves and are held together by the tension of a flat spring around one side. Any die may thus be opened up and slipped on to the member to be re-threaded. The stock is then fitted over the die, and the latter clamped in place by adjusting two screws. The operation is completed by backing off the die, thus restoring the threads. These dies cannot be used for cutting new threads. They are available in USS and SAE threads in all sizes from ¼ in. to 1⅛ in. inclusive.—AVIATION, *December, 1932.*

Four pillar radio tubes

DESIGNED especially for use under vibrational conditions, Eveready Raytheon tubes are now being marketed for use on aircraft radio sets by the National Carbon Company, Inc. The distinguishing feature of these tubes is the mounting of the tube elements on four supporting posts, rather than the two usually employed. It is claimed that this method of construction gives greater strength and rigidity, and protects the accurate spacing of the elements against disturbances caused by mechanical shocks and vibrations. These tubes are available in all the common sizes of d.c. and a.c. detectors, amplifiers and rectifiers.—AVIATION, *December, 1932.*



The Detroit-Cletrac snow broom

Snow sweeper

THE approach of winter brings up the snow removal problem at many airports. A snow broom attachment for Cletrac tractors is being manufactured by the Detroit Harvester Company. A 6-ft. split bamboo broom rotated under power at 150 r.p.m. is mounted on a yoke bolted to the front end of the tractor. A lever system permits raising the broom out of the way when not in use. Due to the angularity of the broom with respect to the tractor, all dirt and snow are removed to one side, leaving a clear path for the tractor.—AVIATION, *December, 1932.*

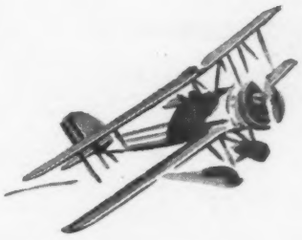
Humidity control

RECENTLY Julien P. Friez & Son's, Inc., a division of Bendix Aviation Corporation, has announced an addition to the line of instruments for recording and controlling temperature and humidity. The new Friez humidistat is a control device intended to maintain definite humidity conditions for certain industrial processes, for example, in dope and fabric shops, by the turning on or off of suitable water sprays through a relay system. Specially prepared human hair is used as the hygroscopic element. A hand index is provided, which can be set along a visible scale to maintain any humidity throughout a range from 20 per cent to full saturation.—AVIATION, *December, 1932.*

Radio beacon trainer

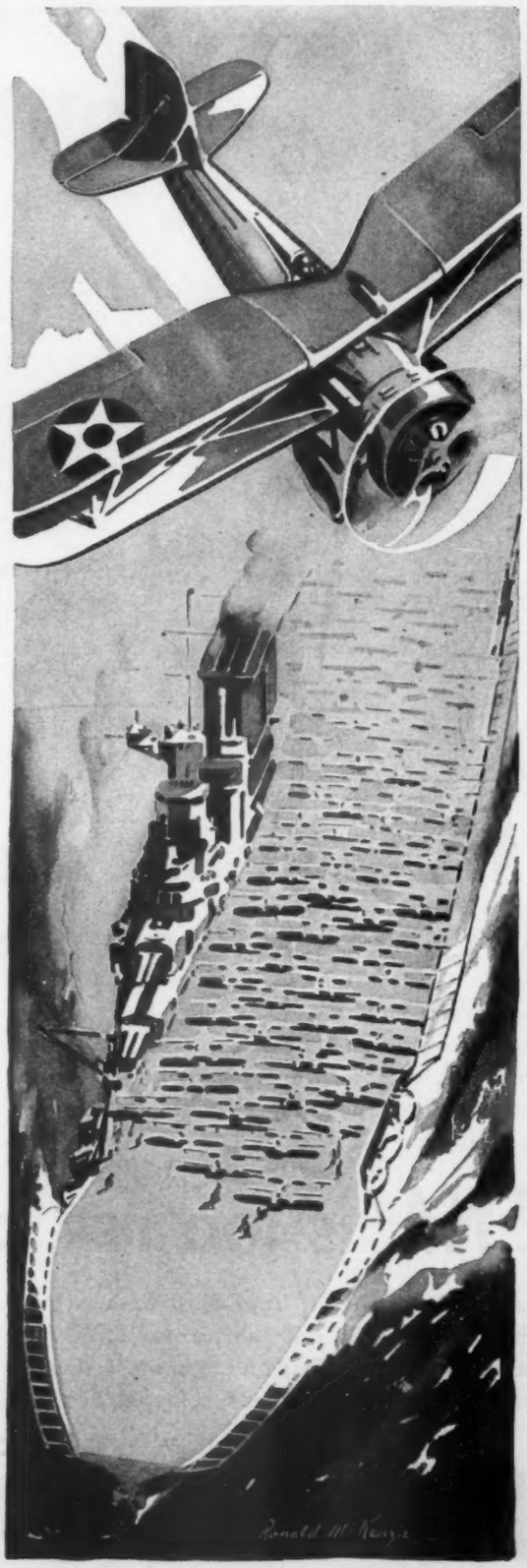
LIEUT. CARL J. CRANE, co-author with Maj. William C. Ocker, of "Blind Flight in Theory and Practice" has developed equipment to simulate radio beacons. In many localities it is impractical to secure extensive beacon training due to inaccessibility of a standard airways beacon. With the Crane trainer installed, however, the instructor or check pilot can set up all types of beacon and blind landing problems.

The device consists of a sending unit which may be mounted in any convenient place in the cockpit floor; a receiving panel for the student's cockpit, consisting of a visual flight indicator, as well as a jack into which the student's headset may be plugged; and a control panel to be mounted in the instructor's cockpit. By manipulating a few simple switches and rheostats, the instructor can simulate any type of beacon signal at any volume he desires. The equipment is simple to install and operate. It is being manufactured and distributed by Hangar Six, Inc., Winburn Field, San Antonio, Tex.—AVIATION, *December, 1932.*



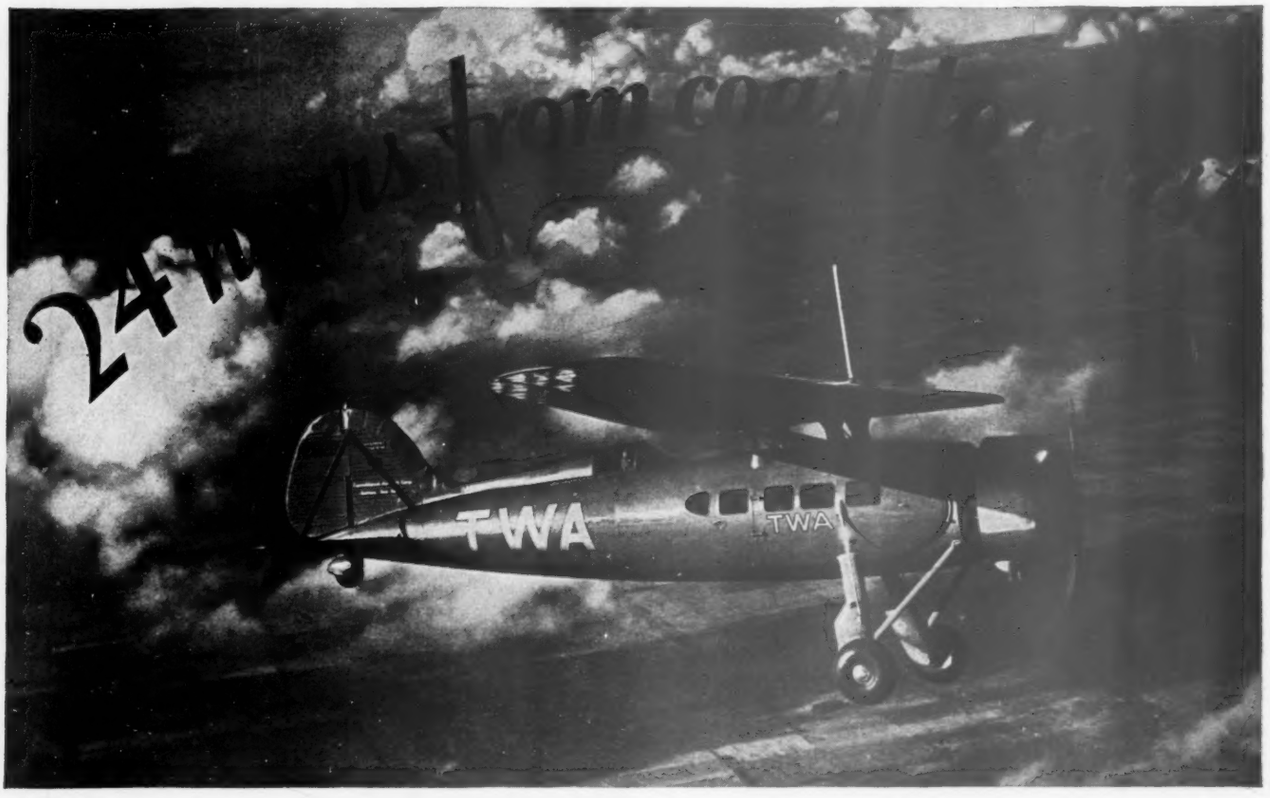
Flying from Floating Fields

Think of a plane that can accelerate from rest to flying speed in a short run on deck. Picture a speed range extending from the fast work of observation to relatively slow deck landing. Consider the structural strength needed for coming in continually on steel and being stopped by arresting gear. Add to those specifications easy handling, flashing performance and intrinsic reliability and you have the Chance Vought Corsair. Chance Vought Corporation, East Hartford, Connecticut. Subsidiary of United Aircraft & Transport Corporation.



CHANCE VOUGHT CORPORATION

One of the new 160 m.p.h. Fleetster planes in operation on the T. W. A. Line between Detroit, Toledo, Fort Wayne and Indianapolis, connecting at the latter point with the new 24-hour coast-to-coast service.



T.W.A. ESTABLISHES A SENSATIONAL RECORD IN COMMERCIAL AIR TRANSPORTATION!

Transcontinental and Western Air, Inc., again lowers its coast-to-coast time.

Patrons of the T.W.A. air transport service can now take dinner in New York any evening and arrive in Los Angeles for the next.

T. W. A., now, with faster planes and readjustments of schedules, cuts 11 hours from its New York-Los Angeles time.

It is the fastest passenger, air mail and air express transcontinental service in the United States.

T.W.A. IS 100 PER CENT TEXACO

A 24-hour continuous flight from coast to coast requires the best in fuel and lubricants. T.W.A., having made exhaustive tests on engine test stands and under actual flying conditions, selected Texaco Aviation Gasoline and Texaco Airplane Oils on their merits for dependability and superior performance. T.W.A. is 100 per cent Texaco.

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TEXACO AIRPLANE OILS · TEXACO AVIATION GASOLINE · TEXACO AERODIESEL FUEL · TEXACO MARFAK GREASES · TEXACO ASPHALT PRODUCTS (for Runways, Hangar Floors, Aprons & Dust Laying)

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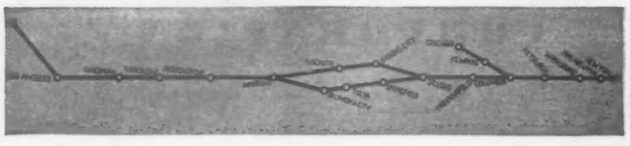
The Lindbergh Line

"SHORTEST ROUTE COAST-TO-COAST"



LACK of regular battery inspection may be piling up your maintenance costs. And the absence of a voltage regulator may be cutting the life of your batteries.

Have your mechanics keep a close check on the battery as well as the generator and voltage regulator. With equipment properly adjusted, you will get more reliable performance and longer life from your batteries. Be sure your generators are voltage regulated and carefully adjusted. Fewer bench charges will be necessary. That means money saved.

But, first of all, give your ships a good battery. One that's built especially for aircraft service. The Exide Aircraft Battery is just this type of battery. Light-weight, compact, safe, dependable. Electrolyte will not spill. The performance of Exides over thousands of miles of sky lanes every day proves this so. Investigate Exides today.

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EXIDE ENGINEERING SERVICE—Technically trained Exide engineers are located near each of the larger airports in the United States, and welcome the opportunity to cooperate with you and help solve difficulties you may now be having with aircraft batteries. There is no charge made for this service. Write us about it today. It's a step toward longer battery life and lower maintenance. It will save you money.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia

The World's Largest Manufacturers of Storage Batteries for Every Purpose

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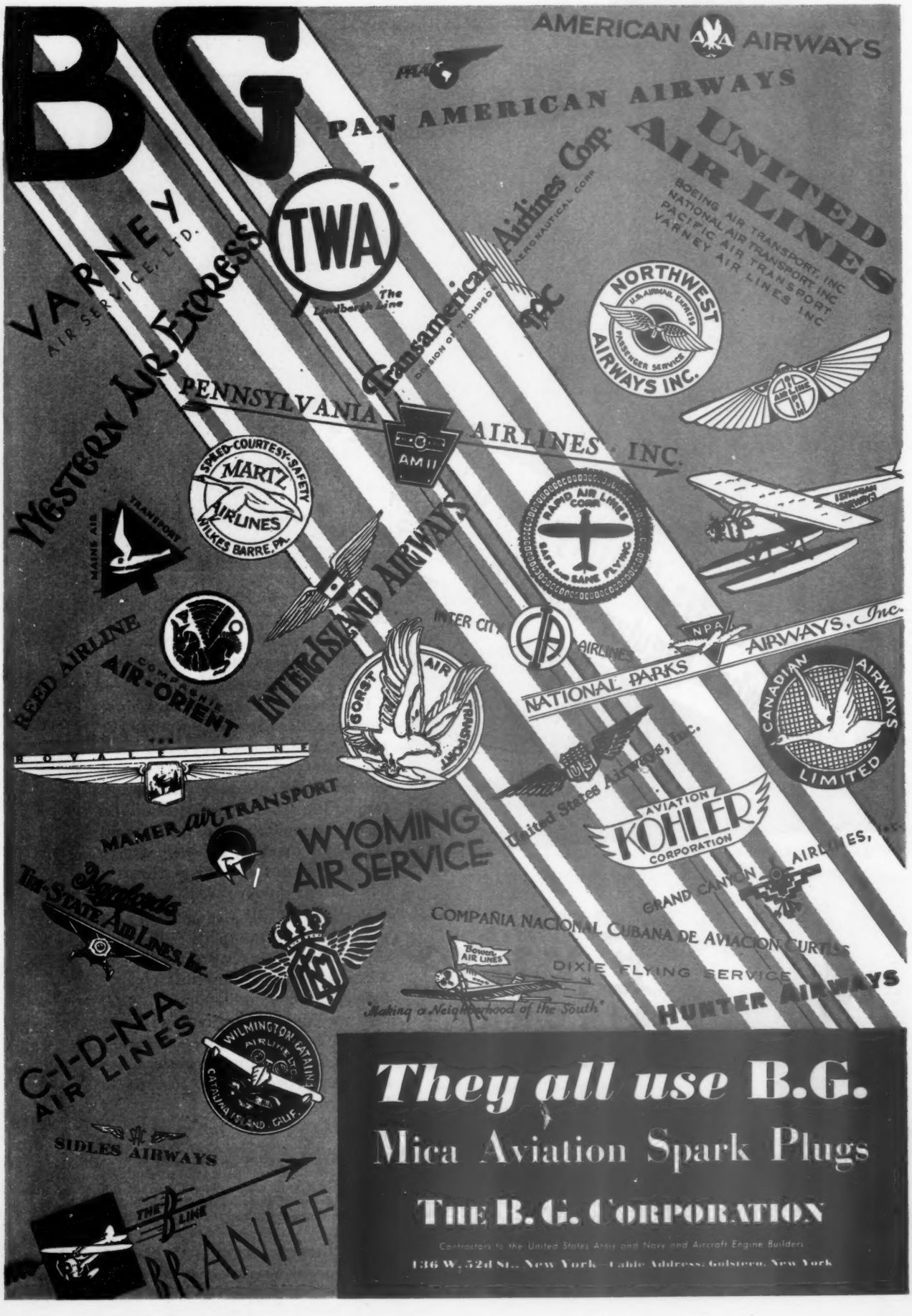
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THE B. G. CORPORATION
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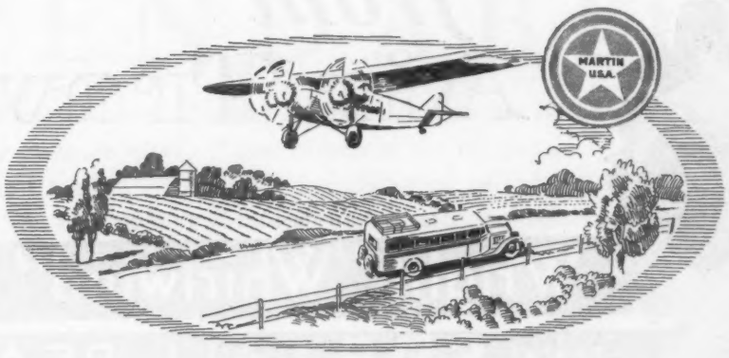

★ TRANSPORT ★

NO TRANSPORTATION EXECUTIVE, concerned with the continuous, economical operation of schedules, would buy a motor bus that was not the standardized product of straight-line, machine production methods. He would realize that otherwise all inspection, servicing, maintenance, and part replacements on his equipment would take too long and cost too much. ★ Yet in the field of air transportation, where savings in time and money are equally important, many airplanes still are produced a few at a time by hand methods. Obviously, although improvements in design will continue to contribute to the progress of flying, the improvements most needed must come from improved methods of manufacture. ★ Fortunately, the Martin Company foresaw this fact years ago, and put that foresight to practical application in the development of its organization and in the layout and equipment of its plant. ★ As a result, it is our sincere conviction that nowhere else in the industry is modern manufacturing efficiency so highly developed; that nowhere else in the industry can aircraft of equal quality be produced at lower cost.

Glenn L. Martin

The Glenn L. Martin Company

Baltimore, Maryland, U. S. A.

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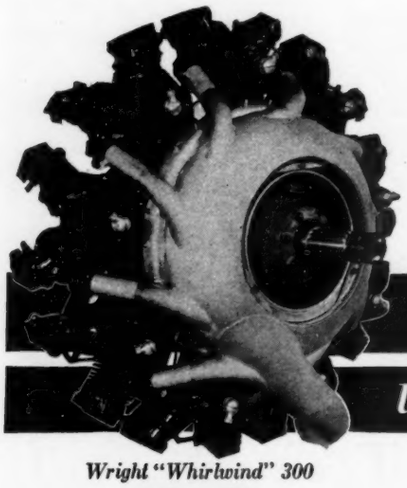
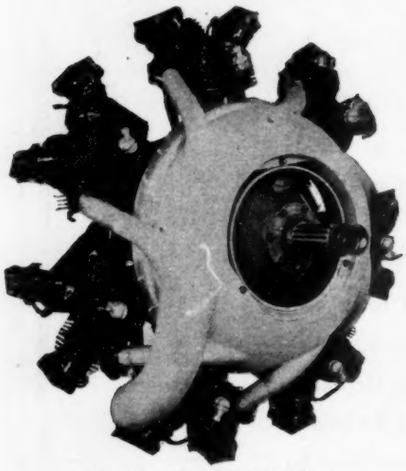
Eliminating Risk *from* Air Travel



Wright "Whirlwind" Engines
***use* SRB BALL BEARINGS**

Wright "Whirlwind" 300



Wright "Whirlwind" 240

Wright "Whirlwind" 165

SRB Ball Bearings have been used on Wright Engines for the last ten years. To any engineer this should be convincing evidence of their dependability. Bear in mind, too, that Wright is not alone in its high regard for SRB Ball Bearings . . . practically all American Aircraft Engine Builders use them.

When Ball Bearings are required for exacting performance, specify SRB—they have the endorsement of an industry that demands DEPENDABILITY.

Marlin-Rockwell Corp.

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GURNEY SRB STROM M·R·C BALL BEARINGS

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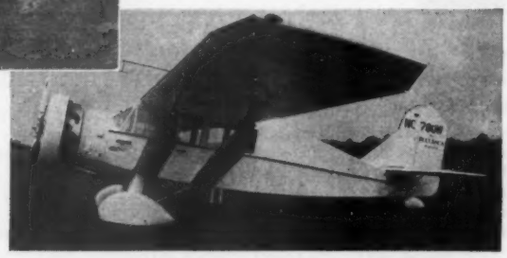
Built for DEPENDABILITY

Bellanca Aircraft of today represent the mature skill and experience of a great designer. These airplanes are far and away the acknowledged leaders of America for efficiency and dependability. Not only in notable, world-famous expeditions, but also in the gruelling tests of everyday service, Bellanca planes have proved themselves utterly reliable.



THE BELLANCA PACEMAKER

Six-place Cabin Monoplane (convertible land and seaplane) with Wright J-6 Series "E" Engine developing 300 h.p.

High Speed .....150 m.p.h.
Cruising Speed .....125 m.p.h.
Range ..... 900 miles
Climb (at sea level) ..... 950 ft./min.
Service Ceiling .....18,000 ft.
Span .....47 ft. 6 in.
Wing Area .....291 sq. ft.
Useful load:
Gasoline ..... 720 lbs.
Oil ..... 60 lbs.
Pilot and payload..1,170 lbs.

Plane also available with following types of engines: Wright J-6 "E" 400 h.p.; P. & W. "Wasp Jr." 300 h.p.; P. & W. "Wasp Jr." 400 h.p.; or Packard-Diesel 220 h.p.

THE BELLANCA AIRBUS

12 to 15 place Cabin Sesqui-plane

High Speed .....154 m.p.h.
Cruising Speed .....135 m.p.h.
Range ..... 948 miles
Climb (at sea level).....790 ft./min.
Service Ceiling .....14,000 ft.
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Pilot and payload..2,820 lbs.

Above performance with Wright "Cyclone" Series "F" Engine, developing 650 h.p.; plane also available with geared or direct-drive P. & W. "Hornet" Engine, or liquid-cooled Curtiss-Wright "Conqueror" Engine.

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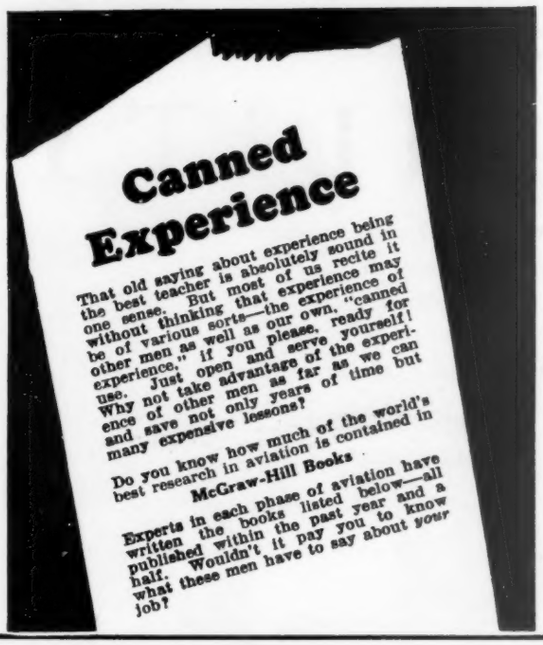
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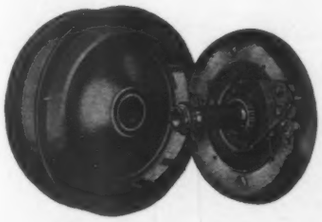

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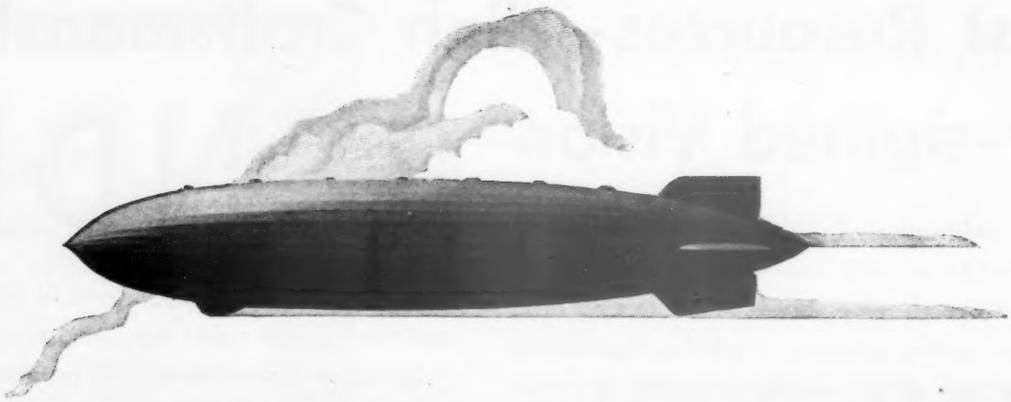

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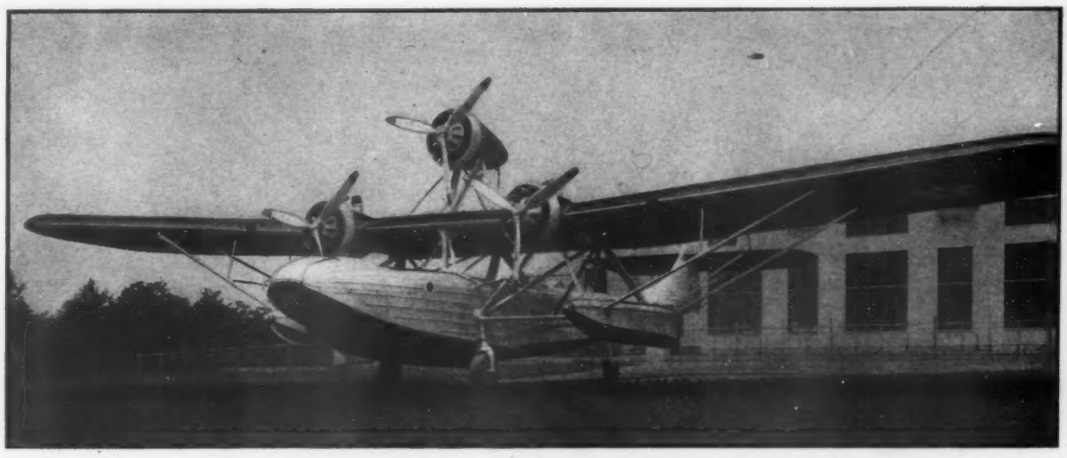

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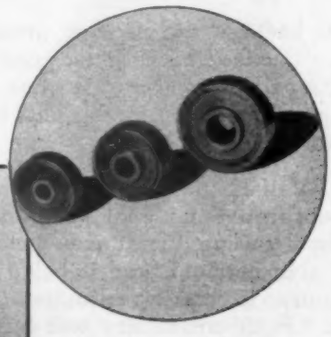

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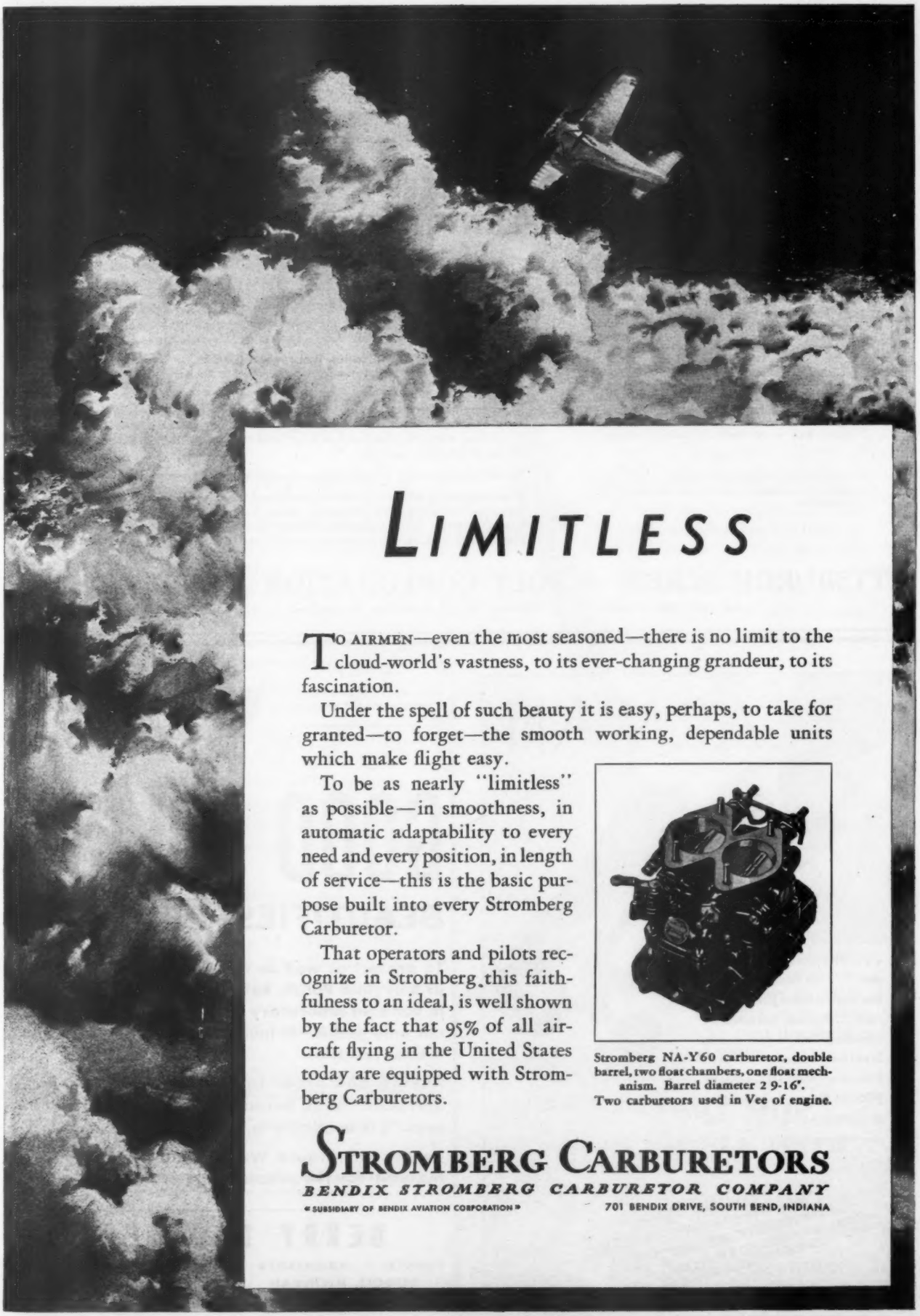

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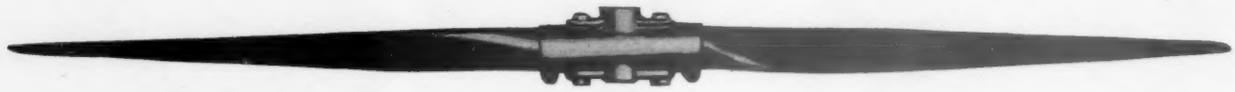

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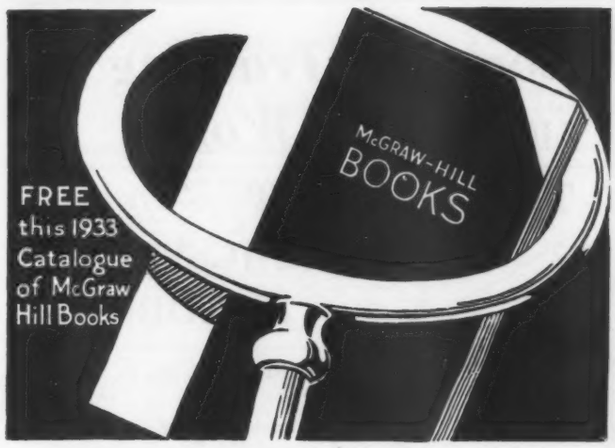

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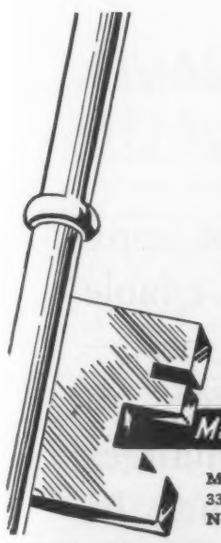

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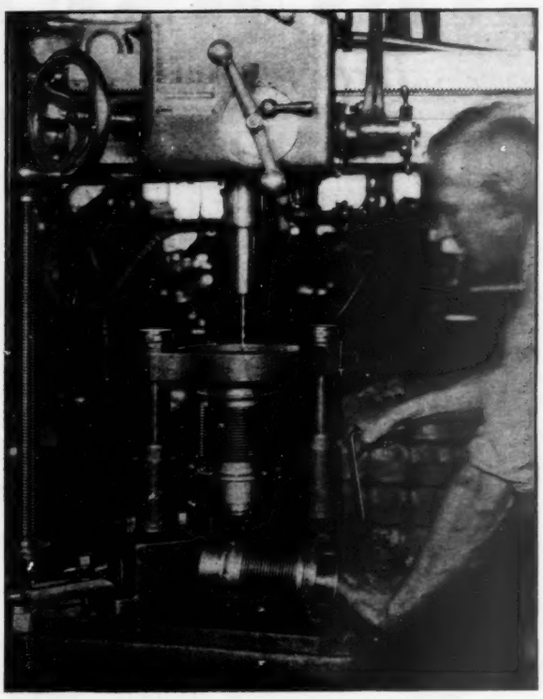

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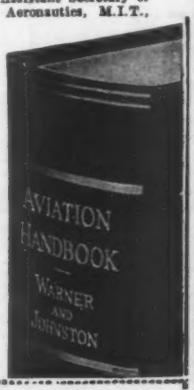

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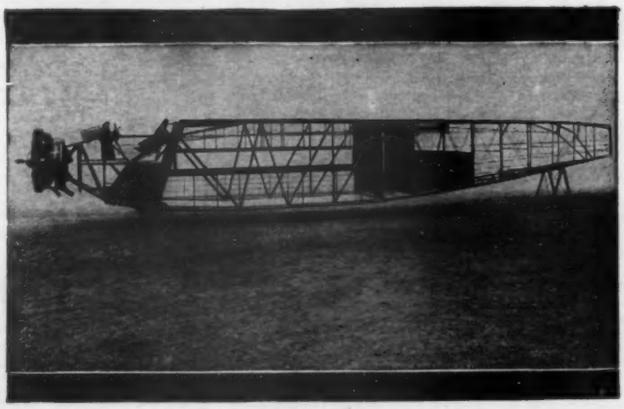

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WACO AIRPLANES

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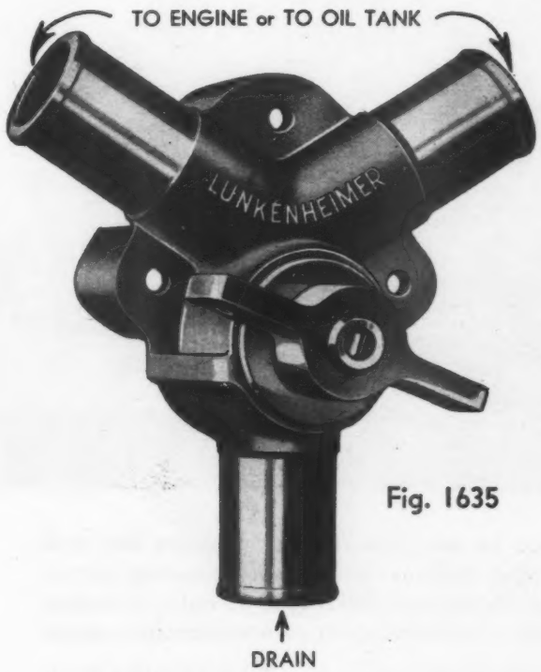

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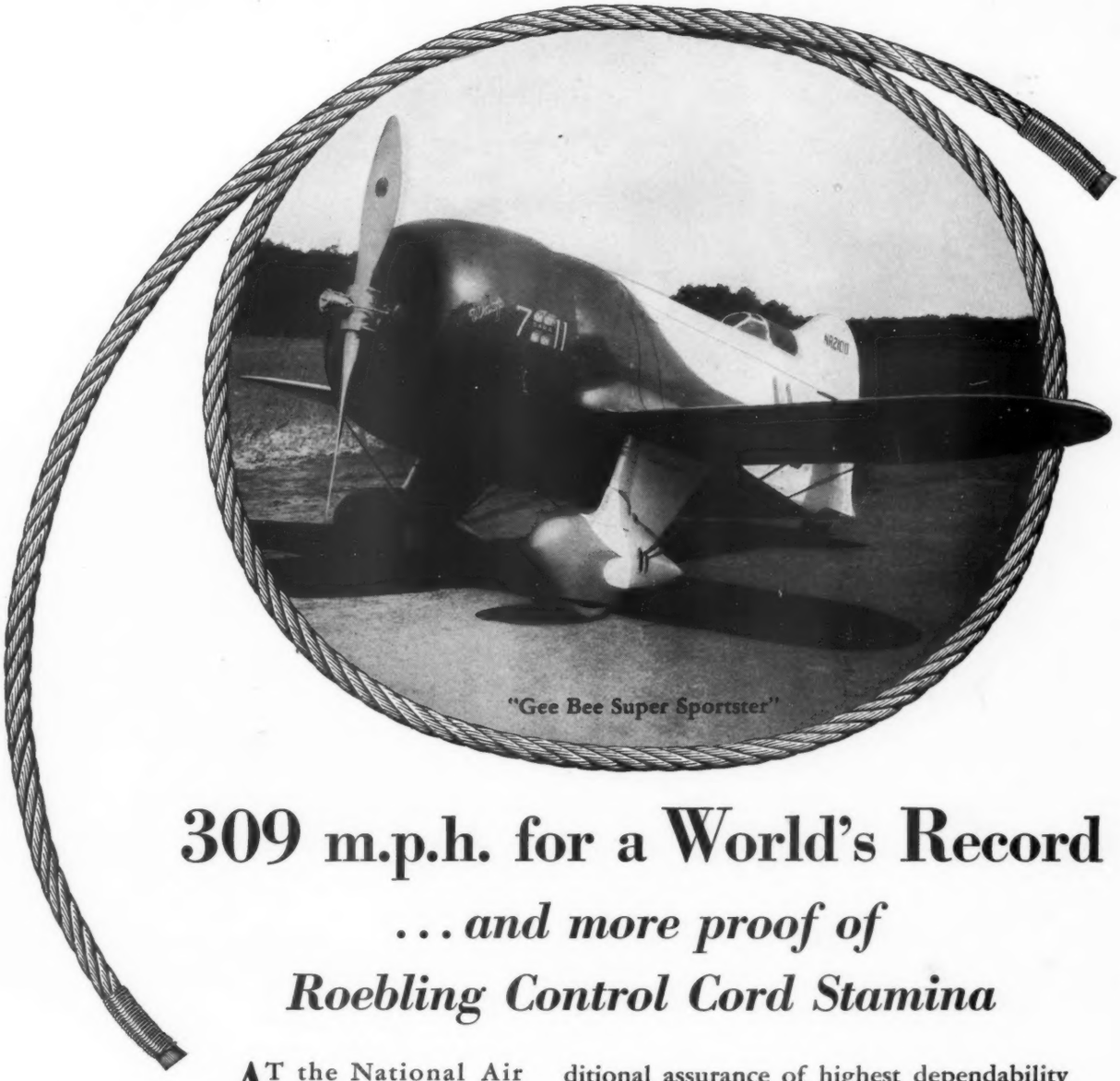

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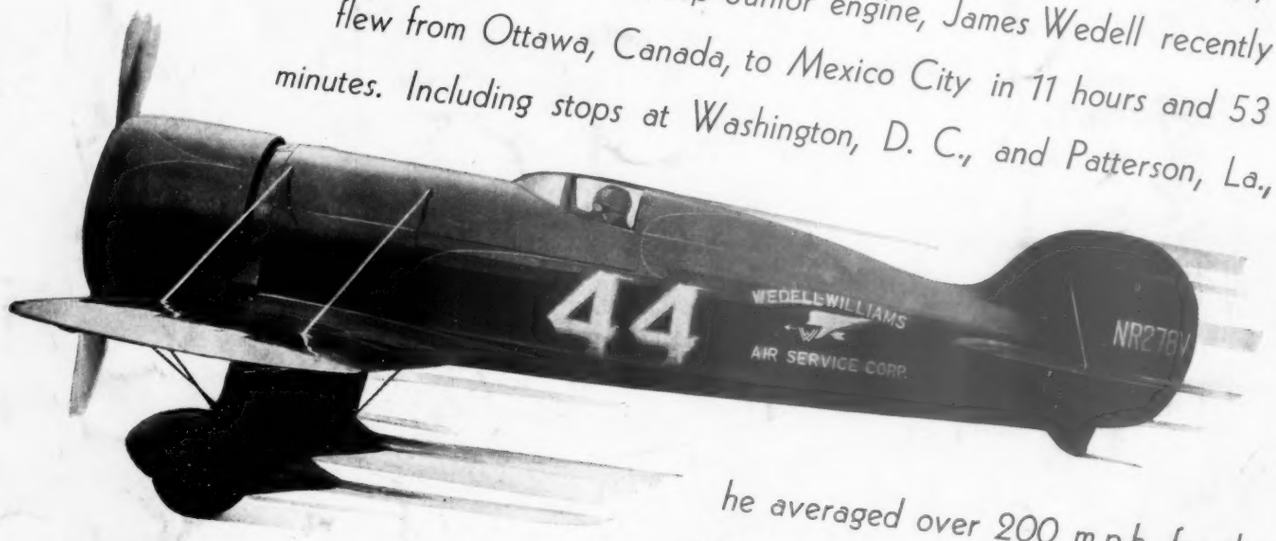

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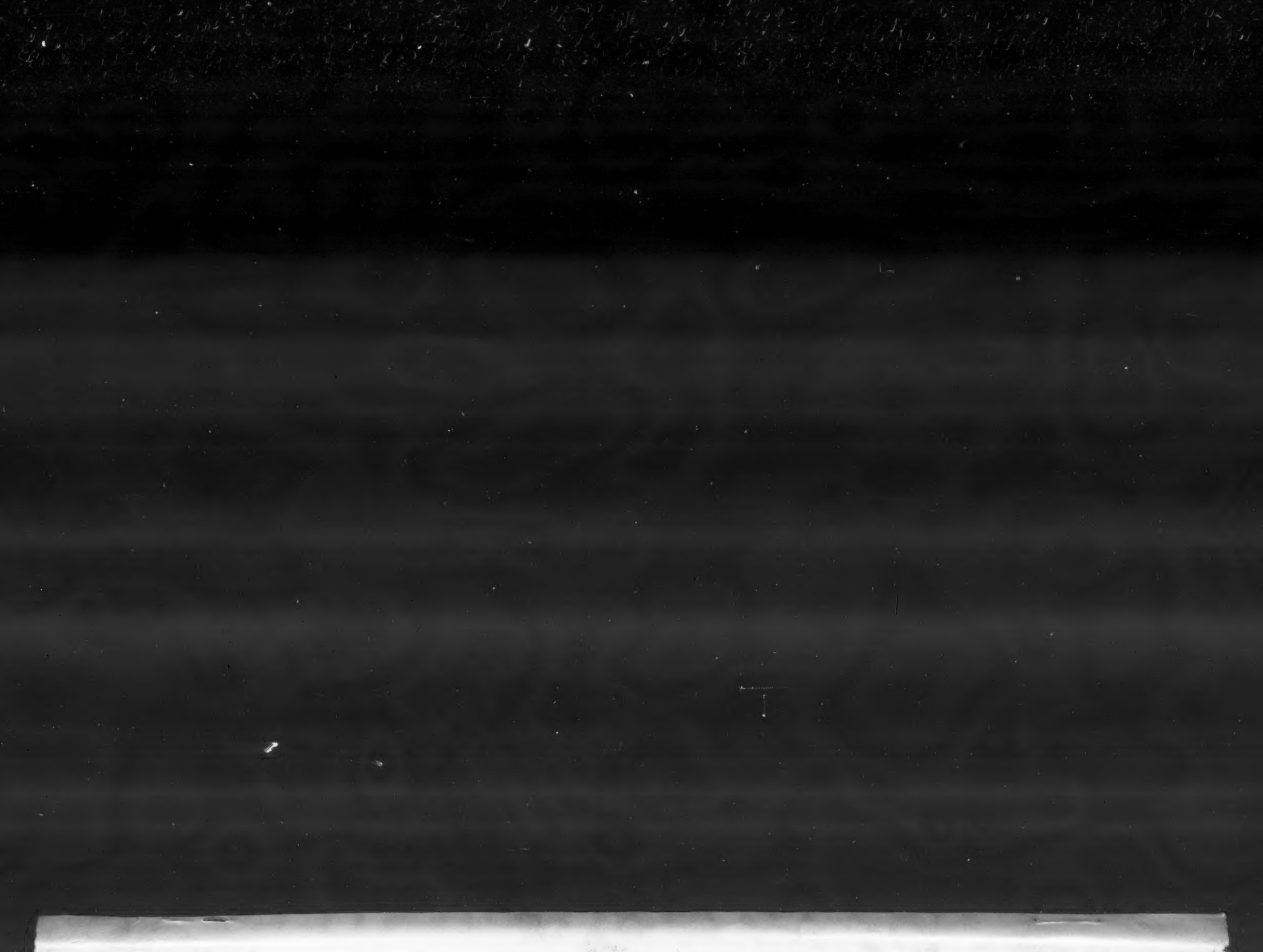
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